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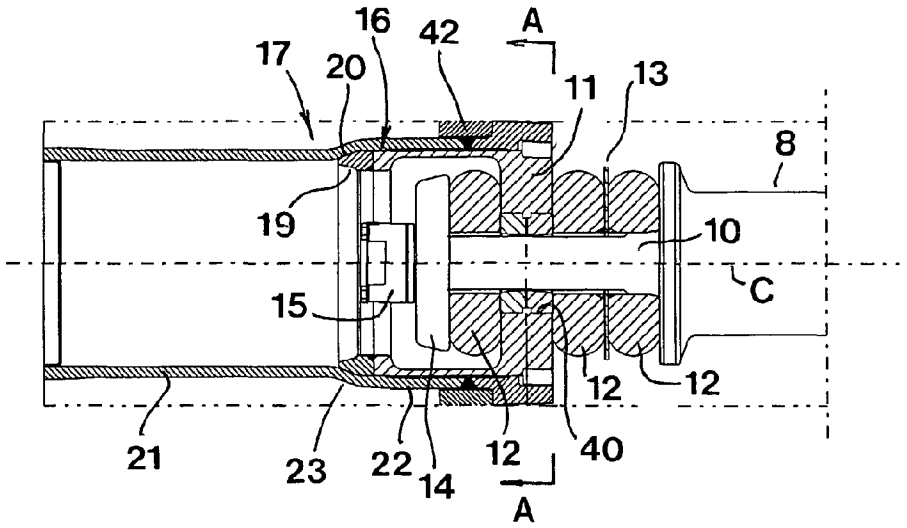
(54) Title: TOWING ARRANGEMENT AND DEFORMATION TUBE IN A RAILWAY VEHICLE COUPLING



(57) Abstract: The invention relates to a towing arrangement being intended for train couplers and of the type that comprises a bar (8), which at a rear end has an axially projecting pin (10), which projects through a through hole (40) in a plate (11), which on botte sides is surrounded by shock-absorbing spring members (12), which always aim to hold the pin in a starting position in relation to the plate, and against the action of which the pin together with the bar are axially movable. According to the invention, the plate (11) is included in a mandrel (16) equipped with a cone (19), which mandrel is inserted into a deformation tube (17), more precisely into a wide, front tube section (22), which via a waist (23) transforms into a thinner, rear tube section (21), which is deformable by the mandrel (16). In a particular aspect, the invention also relates to a deformation tube as such.

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TOWING ARRANGEMENT AND DEFORMATION TUBE IN A RAILWAY VEHICLE COUPLING

Technical Field of the Invention

In a first aspect, this invention relates to a towing arrangement being intended for train couplers and of the type that comprises a bar, which at a rear end includes an axially projecting pin, which projects through a through hole in a plate, which on both sides is surrounded by shock-absorbing spring members, which always aim to hold the pin in a starting position in relation to the plate, and against the action of which the pin together with the bar are axially movable.

Background of the Invention

Although arrangements of the above-mentioned type in practice have the purpose of, between different wheel-supported units, such as cars and/or locomotives, in a train unit transferring not only tractive forces but also thrust forces, the same are commonly denominated "towing arrangements" by those skilled in the art. Characteristic of such towing arrangements is that the same include a bar or registration arm (usually in the form of a tube), which at a rear end in one way or the other is fixed in one of the ends of a frame included in the vehicle unit in question, and which at a front end is connected to one or more additional details while forming a coupler. For instance, the front end of the bar may be directly connected to a coupler head and together with the same form an automatic coupler, but it may also via a muff coupling or the like be connected to a collision protection, which in turn is connected to a coupler head. In the towing arrangement, means are also included in order to absorb shocks of moderate character, i.e., such shock motions that every day arise and are transferred between the vehicle units during travel as well as in connection with coupling of the vehicle units.

Description of Prior Art

In the market, a plurality of different types of towing arrangements are found, the kind initially mentioned of which makes use of spring members as shock-absorbing means. More precisely, one or more spring members are arranged on both sides of a plate having a through hole, in which a pin is inserted that protrudes axially from the rear end of the bar or registration arm of the towing arrangement. These spring members, which for instance may be composed of cushions or bodies of an elastic material, always aim to hold the pin, and thereby the bar, in a given starting position as long as the arrangement is not influenced by any appreciable shock motions, but as soon as shocks arise and manifest themselves in tractive motions in one direction and thrust motions in the opposite direction, these motions are absorbed by the spring members on both sides of the plate. A coupler assembled of just one such towing arrangement and a coupler head can of course absorb mild shocks and vibrations, but not such extreme shock forces that may arise in connection with collisions. Recently, demands have more and more often been raised that the couplers should be provided with particular collision protections, i.e., means, which in contrast to ordinary shock absorbers, have the capability of extincting extreme amounts of kinetic energy with the purpose of reducing and abating to the greatest possible extent the resulting effects in connection with strong collisions. If the couplers should be equipped with such collision protections, previously it has been necessary to place the means serving as collision protection in extension of the proper towing arrangement. In practice, a deformation tube is usually inserted between the towing arrangement and a coupler head. An aggravating disadvantage of this solution is, however, that the collision protection is based on the length, i.e., requires that the coupler in its entirety is given a great length. Furthermore, the solution is manufacturing-wise cost-demanding and results in difficulties with the construction in other respects.

Objects and Features of the Invention

The present invention aims at obviating the above-mentioned problems and at providing an improved towing arrangement for train couplers. Therefore, a primary object of the invention is - in a first aspect - to provide a towing arrangement, in which a collision protection function is integrated in the proper towing arrangement. In other words, a coupler, which makes use of the towing arrangement according to the invention, should be able to assimilate and extinguish such extreme amounts of energy that arise upon collisions, without particular collision protection means needing to be inserted between, for instance, a coupler head and the towing arrangement. An additional object is to provide a towing arrangement that is structurally simple and thereby inexpensive to manufacture. Yet an object of the invention is to provide a towing arrangement, which after the occurrence of an accident has good chances to be restorable at a moderate cost.

According to the invention, at least the primary object is attained by the features defined in the characterizing clause of claim 1. Preferred embodiments of the towing arrangement according to the invention are further defined in the dependent claims 2-6.

In a second aspect, the invention also relates to a deformation tube for the towing arrangement according to the invention. The features of this deformation tube as such are seen in claim 7. An advantageous embodiment of the deformation tube according to the invention is further defined in claim 8.

Further Elucidation of Prior Art

A collision protection in the form of a tube, which is deformable by means of a mandrel equipped with a cone, is previously known per se by EP 1 312 527. However, in this case, the collision protection is built-in in a link coupling, which lacks any shock-absorbing spring member of the type that characterizes the towing arrangement according to the present invention.

Brief Description of the Appended Drawings

In the drawings:

Fig. 1 is a partially cut perspective view showing a towing arrangement made in accordance with the invention and mounted in a frame of a railroad car,

Fig. 2 is an enlarged, partly cut perspective view of solely the towing arrangement,

Fig. 3 is an enlarged, partial longitudinal section through the towing arrangement shown in a primed starting position,

Fig. 4 is an analogous longitudinal section showing the towing arrangement after triggering of the collision protection,

Fig. 5 is an end view A-A in fig. 3, and

Fig. 6 is a longitudinal section through a deformation tube included in the towing arrangement.

Detailed Description of a Preferred Embodiment of the Invention

In fig. 1, 1 generally designates a frame of the type that is included in any vehicle unit (e.g., a car, a locomotive or the like), and which together with other vehicle units may form a train unit. By those skilled in the art, the frame is at times also denominated body or chassis. At one end 2 of the frame, a towing arrangement in its entirety designated 3 is mounted, as well as two dead blocks 4, only one of which is shown in fig. 1. In the shown frame, two plates or panels 5, 6 are included, between which a hollow space 7 is defined. In this hollow space, a rear part of the towing arrangement 3 is accommodated, while a front part of the same protrudes a distance from the end 2 of the frame. In this connection, it should be made clear that the concepts "front" and "rear", respectively, relate to the proper towing arrangement and not to the frame. In other words, for the chosen terminology, it is insignificant whether the end 2 of the car is turned forward or rearward in the train unit.

A substantial part of the towing arrangement 3 consists of a bar or registration arm 8, which in practice

consists of a cylindrical tube. In the example, adjacent to the front end of the bar 8, a muff coupling 9 is shown having the purpose of interconnecting the bar and another component, e.g., a coupler head, for the formation of an automatic coupler. From the rear end of the bar 8 (see figs. 3 and 4), a pin 10 protrudes, which is thinner than the bar 8 and concentric with the geometrical centre axis C of the bar. The pin 10 projects through a hole 40 in a plate designated 11. On both sides of this plate, shock absorbers or shock-absorbing spring members 12 are arranged, which advantageously may consist of cushions or bodies of an elastically deformable material, but which also could consist of mechanical compression springs, e.g., cup springs or screw springs. More precisely, one such spring member 12 is placed on the back side of the plate 11, while two spring members 12 are present on the front side and are mutually spaced-apart by a washer 13. Against the rear spring member 12, a disc 14 is pressed. By means of a retaining element 15, e.g., nut, the disc 14 is kept pressed against the spring member 12 by a predetermined pressure, which yields the desired degree of compression in the spring members 12.

As far as the shown towing arrangement has been described hitherto, the same is in all essentials previously known. However, in previously known towing arrangements of this type, the plate 11 has served as a fastener, which has been fixed directly in the frame of the car or the vehicle unit. In doing so, the towing arrangement has in a satisfying way met not only the purpose of, between connected cars, transferring tractive as well as thrust forces, but also the purpose of absorbing and abating such moderate shock motions that permanently occur during, for instance, travel. However, the towing arrangement has not had any capability of extinguishing such amounts of kinetic energy that arise in connection with possible collisions.

Characteristic of the present invention is that the above-mentioned plate 11 is included in a mandrel in its entirety designated 16, which is inserted into a deformable tube 17, below denominated deformation tube. The mandrel 16

includes, in addition to the plate 11, a cylinder 18 extending rearward from the same, which cylinder at the rear end thereof has a cone designated 19. In the shown, preferred embodiment, the plate 11 and the cylinder 18 are made integrally from a first material, e.g., cast iron. The component made in this way has a shape similar to a barrel. The cone 19 consists in turn of a ring that is of a second material and formed with a conical surface 20, which second material has greater compression strength than the material in the barrel-like component 11, 18. Advantageously, the ring 19 may be manufactured from hardened steel, the ring permanently being united to the cylinder 18, e.g., by welding. The cone angle of the conical surface 20 may advantageously amount to about 40° (2 × 20°).

The deformation tube 17, which is shown separately in fig. 6, and which is of a cylindrical basic shape, includes a rear section 21, which is spaced apart from a wider, front section 22 via a waist 23, which tapers conically from the wide section 22 toward the thin section 21. It is axiomatic that the inner diameter of the section 22 is larger than the inner diameter of the section 21. More precisely, the inner diameter of the section 22 may correspond with - or be very little larger than - the outer diameter of the mandrel 16, as this is determined primarily by the largest diameter of the cone 19. The inner diameter of the section 21 is, however, considerably smaller than the outer diameter of the cone 19. The interior, conical surface, which defines the waist 23, is designated 24. The cone angle of this surface may advantageously correspond with the cone angle (40°) of the conical surface 20 of the ring 19. However, minor angle differences are feasible.

At the front end thereof, the deformation tube 17 has a comparatively robust flange 25, which in the example has been made as a separate component, having a pipe socket 25', which has been united to the rest of the deformation tube via a welded joint 26. The flange 25 has a rectangular contour shape and corbels out from the tube section 22, while the inner diameter of the flange and the pipe socket substantially corresponds with the inner diameter of the

tube section 22. However, adjacent to the ring-shaped end surface 27 of the flange, a ring-shaped groove is recessed, which is defined by a planar, ring-shaped surface 29 as well as a cylindrical limiting surface. In the shown, preferred embodiment example, a female thread 31 is applied in said cylinder surface, which thread may be formed directly in the flange material or alternatively be made in a particular insert ring, which in turn is fixed against the cylinder surface. The width or axial extension of the proper thread 31 is somewhat smaller than the width or depth of the groove.

Said groove has the purpose of receiving a clamp ring 32 having an external male thread 33.

As is best seen in fig. 4, a circumferential groove is also formed adjacent to the front side 34 of the plate 11, which groove is defined by a ring-shaped, planar shoulder surface 36 as well as a cylindrical surface 37. The width of this cylinder surface may advantageously correspond with the width of the ring 32 (as this is counted between planar, opposite end surfaces of the ring), but be somewhat smaller than the depth of the groove that is defined in the flange 25.

In fig. 5 (the cut A-A in fig. 3), it is seen that the pin 10 has an out of round cross-section shape. More precisely, the shape is defined by two planar, parallel surfaces 38, and two curved surfaces 39. The hole 40 in the plate 11, through which the pin 10 is brought, has a substantially square cross-section shape, and is considerably thicker than the pin 10. As is seen in figs. 3 and 4, two insert bodies 41 of an elastically deformable or resilient material, e.g., rubber, are inserted into the hole 40 from opposite directions. In each such insert body 41, a through hole is formed having the same out of round cross-section shape as the pin 10. At least the planar, external surfaces 38 of the pin 10 have fine fit against the corresponding planar inner limiting surfaces in the insert bodies 41. The deformable insert bodies 41 guarantee that the pin 10 normally assumes the rotation angle position that is shown in fig. 5. However, upon the rather frequent occasions when

the bar 8, and thereby the pin 10, is subjected to torsion stresses, the insert bodies permit a certain turning of the pin, although always against the action of the spring force in the material. In other words, the insert bodies form a torsion suspension, which, on one hand, guarantees requisite flexibility in the coupling between two cars, but which on the other hand always brings back the bar (and a coupler head belonging thereto) to a desired starting or normal position.

The Function and Advantages of the Towing Arrangement According to the Invention

First, reference is made to fig. 1, in which the reference designation 42 implies how a vertical wall or panel is fixed in the hollow space 7 of the frame, more precisely at a distance inside the end 2 of the frame. In this panel 42, there is a through, circular opening, the diameter of which is at least somewhat larger than the outer diameter of the coarse section 22 of the deformation tube. Thus, the deformation tube can be inserted through the opening until the flange 25 is pressed against the panel 42. After this, the flange is fixed against the panel by means of suitable fastening elements, e.g., bolts, which are applied in co-operating holes 43 in the flange and the panel, respectively.

When the towing arrangement assumes the starting or normal state thereof (see figs. 1-3), the cone 19 of the mandrel 16 is kept pressed, free of play, against the waist 23 of the deformation tube 17. This takes place by means of the clamp ring 32, which via the threaded joint 31, 33 holds the mandrel in a position in which the cone surfaces 20, 24 are pressed against each other by a certain pressure. Clamping of the mandrel may, per se, take place by means of the threaded clamp ring 32 only. However, in practice, it is preferred to press in the mandrel by means of a strong, hydraulic clamping mechanism (not shown), and then the clamp ring is tightened while forming a stop, which makes axial displacement of the mandrel in the forward direction impossible. In other words, the clamp ring holds

the mandrel in place inside the wide section 22 of the deformation tube. On the contrary, the clamp ring 32 does not prevent the mandrel from moving axially rearward. Such a move of the mandrel is, however, prevented in the normal state according to fig. 3 by the waist 23.

In any normal case, e.g., in connection with travel and coupling occasions, respectively, the motion-damping means of the towing arrangement in the form of the spring members 12 and the insert bodies 41, respectively, work in a conventional way, i.e., tractive, thrust and rotary motions in the coupling between two cars are absorbed in a smooth and careful way.

However, if a collision would occur, in particular a collision during travel at high speed, the collision protection, which together is formed by the mandrel 16 and the deformation tube 17, is activated. In the towing arrangement, an interaction of forces of high kinetic energy is then generated, the bar 8 together with the mandrel 16 being applied an aim to penetrate into the deformation tube. Such penetration may take place without hindrance by the clamp ring 32, in that the smooth cylinder surface 37 of the mandrel freely can get loose from the likewise smooth inside of the clamp ring. When the mandrel 16 has left the clamp ring and started to move rearward, as is shown in fig. 4, the tube 17 is successively deformed during conversion of the kinetic energy into heat energy. In such a way, the kinetic energy is extinguished under quick reduction of the resulting effects of the collision of the cars in the train unit as well as possible passengers therein. In this connection, it should be pointed out that the rear end flange 44 of the bar 8 (see fig. 4) has an outer diameter that is at least somewhat smaller than the outer diameter of the mandrel 16. This means that the end flange 44 of the bar can follow a deep distance into the deformation tube without being stopped by the same. Depending on the nature of the collision and the size of the shock forces, which are generated in conjunction hereby, the mandrel may penetrate differently deep into the deformation tube before all energy has been extinguished. Thus,

in particularly severe cases, the tube may be deformed along the major part of the length thereof.

A substantial advantage of the towing arrangement according to the invention is that the same has an inherent collision protection, which can be realized by structurally simple and inexpensive means. Furthermore, said collision protection function may be integrated in the towing arrangement without the length of the bar projecting from the frame needing to be increased. Thus, the requisite deformation tube can in its entirety be accommodated inside the space already available in the interior of the frame. Another advantage is that the construction of the towing arrangement offers reasonable possibilities of restoring the towing arrangement at low costs after an occurred collision. Thus, it may happen that only the deformation tube is destroyed in connection with the mandrel penetrating into the same and altering the shape thereof during plastic deformation of the material in the tube. However, under favourable circumstances, other components in the arrangement may remain intact, wherein the towing arrangement can be restored to working order by the simple measure of exchanging the deformation tube.

Accordingly, the proper deformation tube constitutes a spare or replacement part, the features of which are seen in claims 7 and 8.

Feasible Modifications of the Invention

The invention is not solely limited to the embodiment described above and shown in the drawings. Thus, the mandrel connected to the bar or the registration arm via the pin may, for instance, be formed in many ways that deviate from the detailed embodiment that has been exemplified in the drawings. The concept "plate", as this is used in the description as well as the claims, should therefore be interpreted in the widest sense. Hence, instead of an equally thick plate, the front part of the mandrel may have any suitable shape, provided that the part in question is suitable for the recession of a through hole for the pin

and for the pressing of shock-absorbing spring members against the same.

Claims

1. Towing arrangement for train coupler, comprising a bar (8), which at a rear end includes an axially projecting pin (10), which projects through a through hole (40) in a plate (11), which on both sides is surrounded by shock-absorbing spring members (12), which always aim to hold the pin in a starting position in relation to the plate, and against the action of which the pin together with the bar are axially movable, c h a r a c t e r i z e d in that said plate (11) is included in a mandrel (16) equipped with a cone (19), which mandrel is inserted into a deformation tube (17), more precisely into a wide, front tube section (22), which via a waist (23) transforms into a thinner, rear tube section (21), which is deformable by the penetration of the mandrel.

2. Towing arrangement according to claim 1, c h a r a c t e r i z e d in that the mandrel (16), in addition to said plate (11), includes a cylinder (18) extending rearward from the same, which in turn at a free, rear end has said cone (19).

3. Towing arrangement according to claim 2, c h a r a c t e r i z e d in that the plate (11) and the cylinder (18) are made integrally from a first material, while the cone consists of a ring (19) that is of a second material and formed with a conical surface (20), which second material has greater compression strength than the first-mentioned one.

4. Towing arrangement according to any one of the preceding claims, c h a r a c t e r i z e d in that the mandrel (16) in a primed starting position is kept in place in the deformation tube (17) by means of a clamp ring (32), which, on one hand, prevents the mandrel from moving axially forward out of the tube as long as the mandrel is influenced by moderate forces only, but on the other hand freely allows the mandrel to move rearward from the same into the thin section (21) of the tube (17), so as to deform the

same, if the mandrel is subjected to considerable compressive forces.

5. Towing arrangement according to claim 4, c h a r a c t e r i z e d in that the clamp ring (32) is connected to the deformation tube (17) via a threaded joint in the form of a male thread (33) on the outside of the ring and a female thread (31) on the inside of the tube, the clamp ring having the purpose of, in the starting position, holding the cone (19) of the mandrel pressed, free of play, against the waist (23) between the thin and wide, respectively, sections (21, 22) of the tube.

6. Towing arrangement according to claim 4 or 5, c h a r a c t e r i z e d in that the mandrel (16) at a front end (34) has a circumferential groove, into which an internal part of the clamp ring (32) engages.

7. Deformation tube for towing arrangement for train coupler, c h a r a c t e r i z e d in that the same has a cylindrical basic shape and comprises a rear section (21), which via a conically widening waist (23) transforms into a wider front section (22), to which a flange (25) is united for the fixation of the deformation tube in a frame or chassis of a vehicle unit, and that internally in the wide, front section, there is means (31) in order to secure a clamp ring (32).

8. Deformation tube according to claim 7, c h a r a c t e r i z e d in that said means consists of a female thread (31) arranged to co-operate with a male thread (33) of the clamp ring (32).

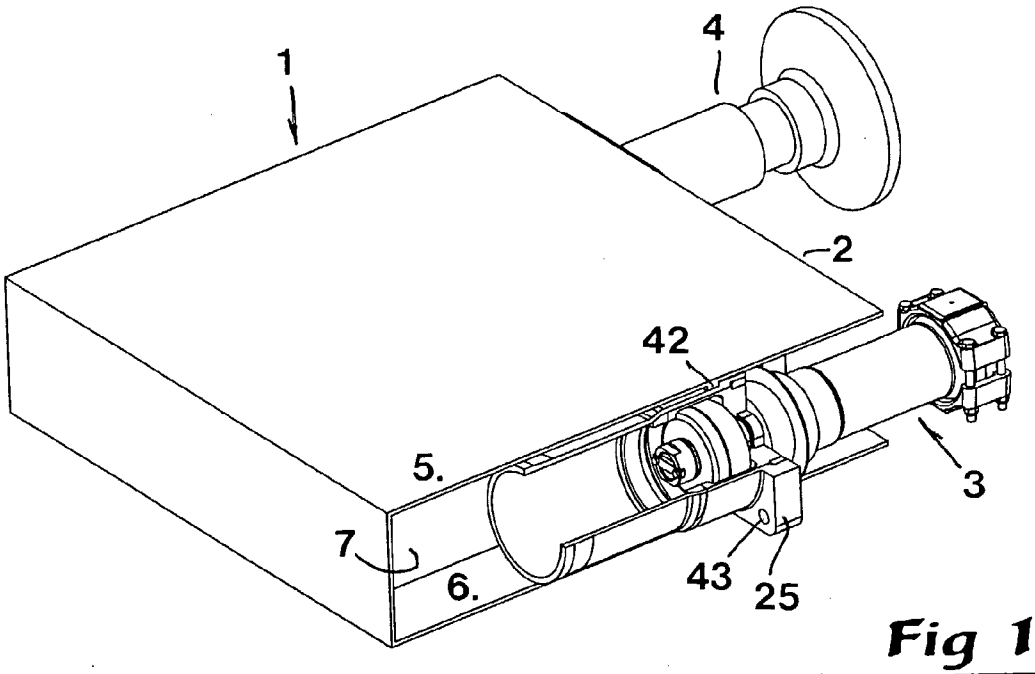

Fig 1

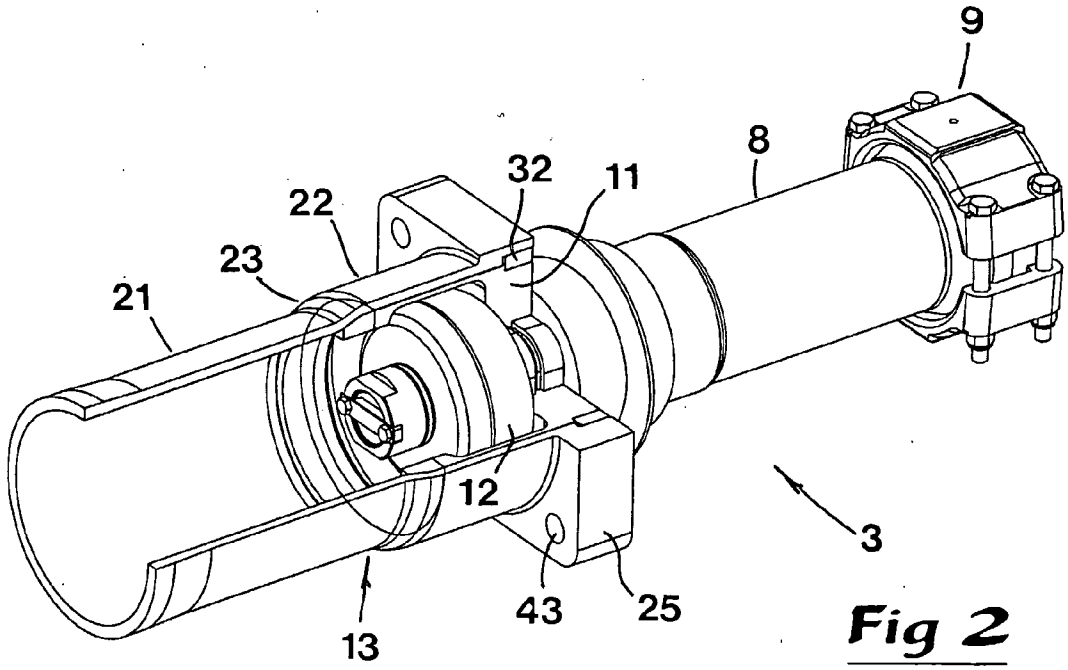

Fig 2

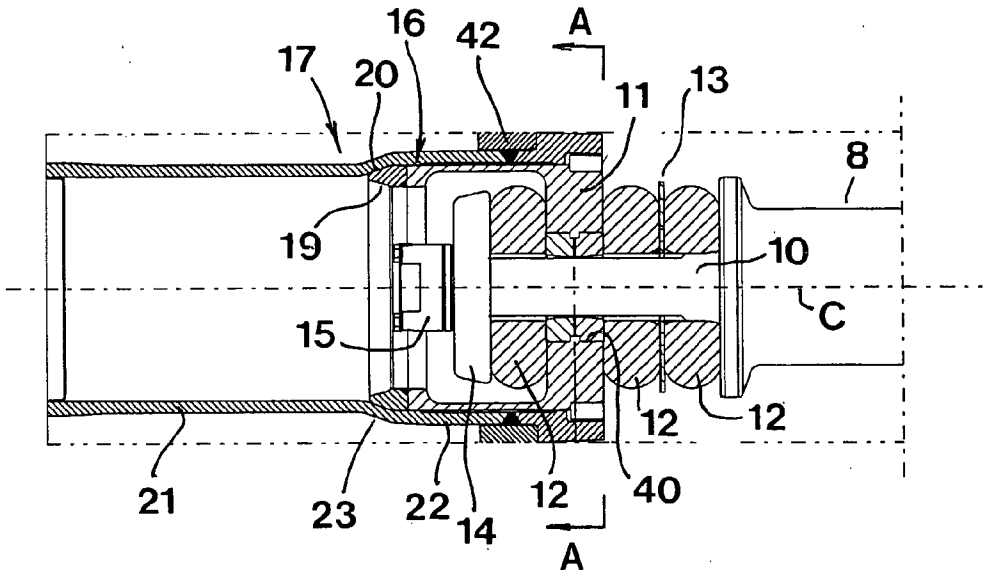
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Fig 3

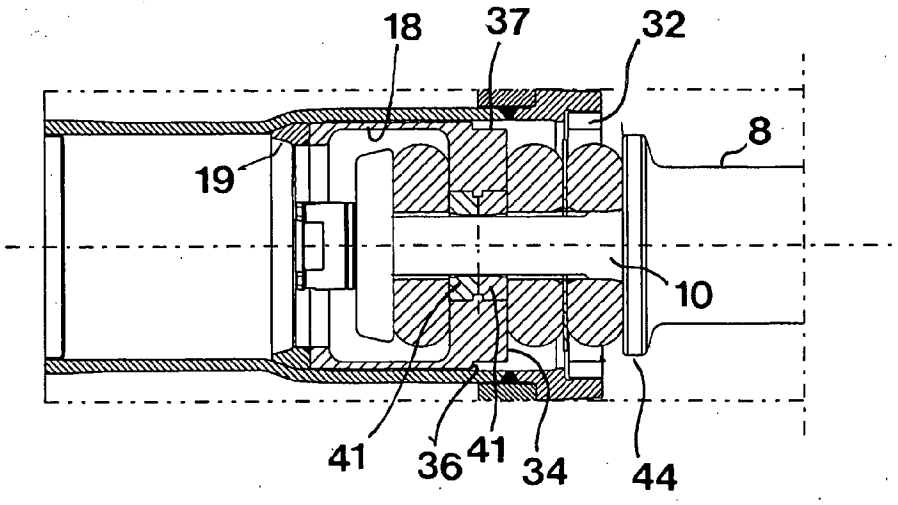
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Fig 4

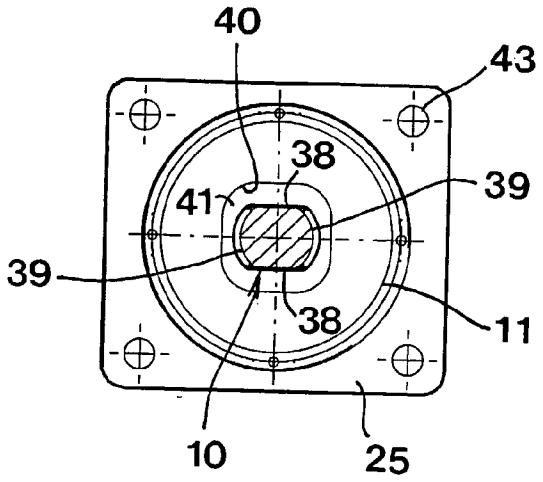

Fig 5

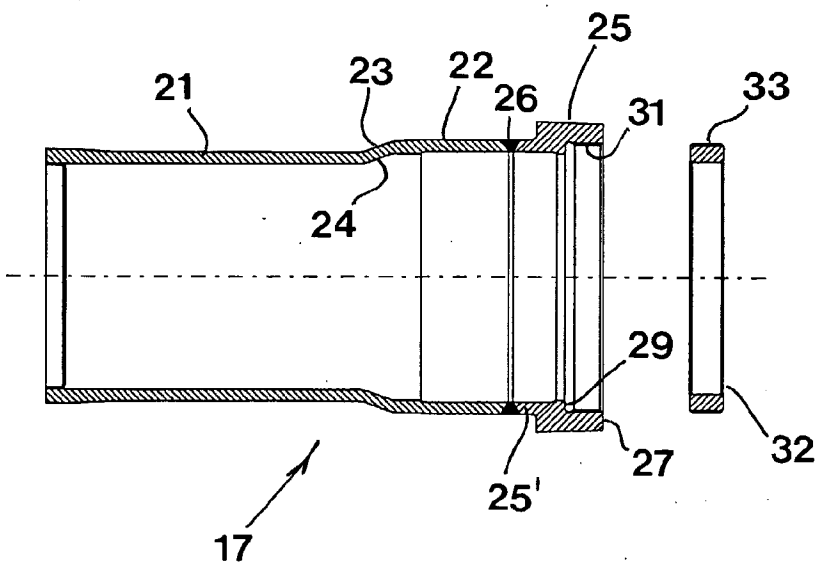

Fig 6

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 2005/000071

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: B61G 5/02, B61G 9/04
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: B61G, F16F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-INTERNAL, WPI DATA, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 6446820 B1 (R.E. BARKER ET AL), 10 Sept 2002 (10.09.2002) ---	1-8
A	EP 1247716 A1 (OLEO INTERNATIONAL LIMITED), 9 October 2002 (09.10.2002) ---	1-8
A	EP 1312527 A1 (VOITH TURBO SCHARFENBERG GMBH & CO. KG), 21 May 2003 (21.05.2003) --- --------	1-8

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

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"P" document published prior to the international filing date but later than the priority date claimed
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"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
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Date of the actual completion of the international search	Date of mailing of the international search report
20 April 2005	06 -05- 2005
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Christer Jönsson / MRo Telephone No. +46 8 782 25 00

Form PCT/ISA/210 (second sheet) (January 2004)

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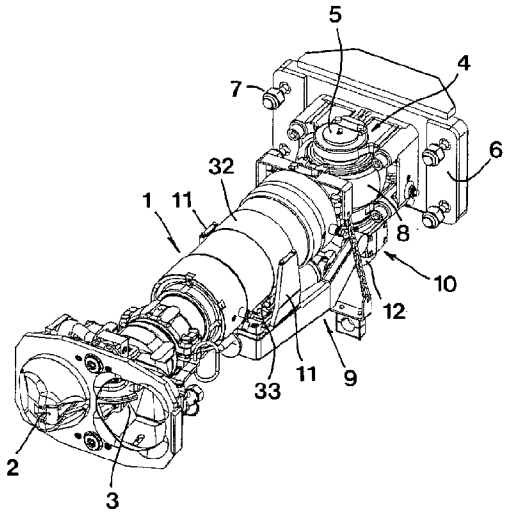

(57) Abstract: The invention relates to a car coupler of the type that comprises a coupling rod (1), which is laterally swingable by, at a rear end, being connected to a main joint (4), and which at a free, front end includes coupling members (2, 3) for connection with analogous coupling members on other car couplers. A holder mechanism is arranged to secure the coupling rod in a non-swingable neutral position when the car coupler is inactive. According to the invention, a bracket-like carrier (9) is arranged under the coupling rod (1), which carrier is connected to a turnable ring (12) included in a house (10) arranged under the main joint (4), in which house the holder mechanism (not visible) is integrated. Furthermore, the coupler includes drivers (11), which have the purpose of forcing the carrier (9) and the coupling rod (1) to slavishly follow each other during swinging, the coupling rod (1) resting in an axially free-flowing state on the carrier (9) so far that the coupling rod and the carrier are free to move backward and forward in relation to each other.

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VEHICLE COUPLER

Technical Field of the Invention

This invention relates to a car coupler of the type that comprises a coupling rod, which is laterally swingable by, at a rear end, being connected to a main joint and which at a front, free end includes coupling members for connection with analogous coupling members on other car couplers, a holder mechanism being arranged to secure the coupling rod in a non-swingable neutral position when the car coupler is inactive.

Background of the Invention

Car couplers of the above-related kind are found on pulled railroad cars as well as pulling locomotives, and have frequently the form of automatic couplers, i.e., couplers that enable automatic connection without manual handling of the proper coupling members. In practice, such couplers are centrally placed on the individual end of the car body or chassis, and swingable in order to, among other things, enable connection of cars that are placed in curves, i.e., on railway tracks that are more or less markedly curved. During ride, the couplers should be continued swingable for the trains to be able to alternatingly pass right-hand curves as well as left-hand curves. However, when the individual coupler is inactive, i.e., not connected to the coupler of another car, the same has to be reliably retained in a neutral position, which usually consists of an intermediate position in which the same points perpendicularly out from the end of the car, because otherwise the coupler would dangle to and fro during ride. Furthermore, generally characteristic of the car couplers is that they are subjected to constant as well as occasional, vertical loads of considerable size, namely in the form of the dead weight of the coupler, which may amount to 400-500 kg, and unforeseeable force loads, for instance of the type that arise when a person jumps up and stands on the coupler. In the last-mentioned case, the bending moment on the

coupling rod becomes particularly large if the person is sturdily built and stands near the free end of the coupling rod. For these reasons, some form of auxiliary support is usually required – at least for long couplers having a large dead weight – that counteracts and compensates the vertical stresses. In this connection, it should also be mentioned that the coupling rods of the couplers are swingable not only laterally, but to a certain extent also vertically in order to enable ride in hilly topography.

Description of the Prior Art

Common to previously known car coupler constructions is that the above-mentioned support and holder functions have been realized by means of one and the same equipment, more precisely an equipment that demands fixing in the coupling rod at a point located a distance out from the rear turnable ring or vertical joint of the coupling rod. Thus, a usually occurring equipment of this type is composed of two long narrow (mechanical or pneumatic) compression spring devices, which at rear ends are articulately connected to the car body or a fastening plate fixed against the same, and extend obliquely forward/inward against the coupling rod and are connected to the same via front joints located at a considerable distance from the rear end of the coupling rod. When the coupler during ride swings towards one side, the spring device is compressed on the same side, but as soon as the coupler is detached, the compressed spring device guarantees an automatic return of the coupling rod to a neutral position pointing straight ahead, in which the same is retained by the two spring devices together. By the fact that the spring devices are placed in the area of the bottom part of the coupling rod, the same can simultaneously be utilized in order to, via the front joints, apply a spring force pressing in the direction from below to the coupling rod, which force counteracts the vertical bending moment that acts on the coupling rod as a consequence of the dead weight thereof and/or occasional loads.

Although the above-mentioned equipment is technically simple, the same is associated with a plurality of disadvantages. One disadvantage arises in connection with coupling work in curves. Namely, although the front coupling members on the coupler act automatically, the coupler has to be manoeuvred in a manual way, more precisely so far that the coupling rod depending on the curve radius is swung out to such an angle of deflection that the coupling members come to engagement with the corresponding coupling members on analogous couplers of another car. However, swinging out the coupler from the neutral position in a manual way is an extremely force-requiring and ergonomically trying work, in particular if the curve radius is small and demands a large angle of deflection, in that the spring force in the spring devices increases progressively with increasing angle of deflection. Another disadvantage is due to the fact that the spring devices demand fixing on the car body as well as at a point located a significant distance out on the coupling rod. Thus, need for making the couplers retractable has recently arisen, more precisely in such a way that the coupling rod together with the main joint should be possible to draw in telescopically in the backward direction. For physically geometrical reasons, such couplers are impossible to realize if position holding and supporting spring devices simultaneously have to be fixed along the outside of the coupling rod and on the car body, respectively. Another disadvantage of the previously known, diagonally arranged spring devices is that they are space-demanding.

Objects and Features of the Invention

The present invention aims at obviating the above-mentioned disadvantages of previously known car couplers and at providing an improved car coupler. Therefore, a primary object of the invention is to provide a car coupler, which can be connected to and from other couplers in a convenient and smooth way, also when the appurtenant cars are placed in curves. An additional object is to provide a car

coupler, the supporting and position holding functions of which are separated, more precisely with the purpose of obviating the need for fastening details on the outside of the coupling rod and thereby create conditions for realization of retractable couplers. It is also an object of the invention to provide a car coupler, the holder mechanism of which occupies little or no space.

According to the invention, at least the primary object is attained by the features that are defined in the characterizing clause of claim 1. Preferred embodiments of the car coupler according to the invention are furthermore defined in the dependent claims.

Summary of the Invention

The invention is based on the intention to separate the supporting and position holding functions, respectively, of the car coupler, more precisely by arranging, in the area below the coupling rod of the coupler, a bracket-like carrier, which is so constructed that the same together with the coupling rod slavishly follow each other in the lateral swings, and which co-operates with a holder mechanism that is included in a rear house. In such a way, the coupling rod can be placed resting in an axially free-flowing state on the carrier at the same time as retention of the coupling rod of the unconnected coupler in the neutral position is guaranteed by means of the holder mechanism integrated in said house, i.e., without any spring devices needing to be connected to the outside of the coupling rod.

Further Elucidation of Prior Art

By EP 1321344A1, a car coupler is previously known, which in the area below the rear, vertical main joint of the coupling rod includes a house in which a motor-driven adjusting mechanism is built-in, by means of which the coupling rod can be set at arbitrary angles of deflection. However, in this case the coupler lacks every supporting means. Furthermore, the disclosed construction is cost-

demanding and to a certain extent space-demanding so far that the adjusting mechanism includes two projecting pressure devices.

Brief Description of the Appended drawings

In the drawings:

Fig. 1 is a perspective view of a car coupler according to the invention shown in its entirety,

Fig. 2 is a perspective view just showing a carrier according to the invention included in the coupler,

Fig. 3 is a perspective exploded view of the carrier according to fig. 2,

Fig. 4 is a longitudinal section through the carrier according to figs. 2 and 3,

Fig. 5 is a side view of the carrier shown in a first functional position,

Fig. 6 is a side view corresponding to fig. 5 showing the same carrier in another functional position,

Fig. 7 is a horizontal, enlarged section showing the inside of a house co-operating with the carrier, in which house a holder mechanism is built-in, the mechanism being shown in a state in which the coupling rod of the coupler is kept fixed in a forward pointing neutral position,

Fig. 8 is a section corresponding to fig. 7 showing the mechanism set in a position where the coupling rod is swung to a certain angle of deflection, and

Fig. 9 is a perspective exploded view showing different details included in said house.

Detailed Description of a Preferred Embodiment of the Invention

In fig. 1, a coupler is shown in the form of an automatic coupler, which in a conventional way includes a coupling rod 1, which at a front, free end includes coupling members 2, 3 and at a rear end is connected to a main joint generally designated 4. In said main joint, on one hand, a vertical axle or axle spindle 5 is included, which

at upper and lower ends is connected to a fastening plate 6, which is possible to fix on an appurtenant car body (not shown), e.g., by means of a screw or bolt joint indicated at 7. In practice, the fastening plate 6 is placed in the middle of the end of the car body in question, with the plate on a vertical plane from which the coupling rod 1 protrudes substantially horizontally. Furthermore, the main joint 4 includes a ring 8 surrounding the axle 5, which ring is turnable backward and forward in relation to the axle and to which the coupling rod is united. In other words, the main joint enables lateral swinging of the coupling rod 1, e.g., at a 45° angle of deflection to each direction from the position shown in fig. 1. Furthermore, the main joint 4 includes means, not shown, in order to enable turning of the coupling rod as well as limited vertical swinging of the coupling rod in relation to the fastening plate. Since said means lack importance for the understanding of the invention, the same are not accounted for in detail.

Already now it should be made clear that the coupling rod in fig. 1 is shown in a neutral or starting position, in which the coupling rod points straight ahead, i.e., perpendicularly to the fastening plate 6. From this neutral position, the coupling rod may be variably swung towards the left as well as the right to maximum angle of deflection.

The physical shape of the coupling rod 1 is incidental. However, in practice, the main part of the coupling rod is tubular or cylindrical, as is shown in fig. 1. It should also be mentioned that the coupling rod may be built up by one or more modules having most varying purposes, e.g., shock absorber, collision protection, etc.

As far as the shown coupler has been described hitherto, the same is previously known.

Characteristic of the coupler according to the invention is that there is a bracket-like carrier in its entirety designated 9 under the coupling rod 1, which is connected to a turnable ring included in a house 10

arranged under the main joint 4, in which a holder mechanism is integrated or built-in, the nature of which will be described in detail below, reference being made to figs. 7-9. Between the carrier and the coupling rod, two drivers 11 act, which compulsorily ensure that the carrier and the coupling rod slavishly follow each other during occurring lateral swings. Between these drivers, the coupling rod 1 rests in an axially free-flowing state on the carrier, so far that the coupling rod and the carrier are free to move axially backward and forward in relation to each other. In the embodiment shown, the drivers 11 have the form of plates or uprights, which are mounted on the carrier 9 and protrude from the same. In this connection, it should, however, be pointed out that the number of drivers and the location of the same is not critical. Thus, it is feasible to arrange only one driver, either on the carrier or on the coupling rod. Thus, the only significant is that the driver conveys the carrier when the coupling rod swings at the same time as axial relative motions between the coupling rod and the carrier are allowed.

Now reference is also made to figs. 2-6, which more in detail illustrate the carrier 9 together with the house 10. Like the main joint 4, the house 10 includes an external ring 12, which is turnable in relation to an inner, core-like part generally designated 13.

In the shown, preferred embodiment, the carrier 9 has the form of a fork, which comprises two branches 14, the rear ends of which are connected to the turnable ring 12 via a horizontal joint in its entirety designated 15, and the front ends of which are stiffly united to a common end piece 16. The joint 15, i.e., the horizontal, imaginary geometrical axis around which the fork-shaped carrier 9 is swingable in the vertical direction, is constituted of two sets of sleeves 17, washers and screws (see fig. 3), which are applicable in loops 18 at the rear ends of the fork branches, and connectable to fasteners 19 on the outside of the ring 12. With the carrier, a compression spring device 20 co-operates, which extends between a front portion of

the carrier and a second joint 21 (= geometrical joint axis) located on a level below the joint 15. This joint is formed by a pin 22, which is applied in a loop 23 on the rear end of the spring device 20 and is in engagement with two spaced-apart ears 24 on the ring 12. At the front end thereof, the compression spring device 20 is articulately connected to the end piece 16. The same is in the form of a sleeve welded against the fork branches 14 and having a bottom 25 (see fig. 4) in which there is a hole for a front, threaded shank 26 that can be secured in relation to the end piece by means of a nut. Although the compression spring device per se could be of pneumatic and/or hydraulic type, in the example the same is mechanical. More precisely, the device includes two cylinders 27, 28, movable telescopically in relation to each other, the first-mentioned one of which is connected to the shank 26 and the last-mentioned one has a rear bottom 29 connected to the joint 21. On the rear end of the shank 26, there is a piston-like holder-on 30. Between said holder-on and the bottom of the tube 29, a compression spring package (not shown) is arranged, which always strives to distance the holder-on and the bottom of the tube from each other. In other words, a compression spring force of a considerable size always acts between the joint 21 and the front end piece 16 of the carrier.

The fork branches 14 are angular by including, on one hand, front sections 14', which are substantially parallel to the compression spring device 20 and located beside the same, and on the other hand two rear sections 14", which extend upward/rearward from the front branch sections at an obtuse angle to the same. In such a way, a level difference is provided between the joints 15 and 21, which is required in order to bring about a leverage between the turnable ring and the free, front end of the carrier, more precisely so far that the spring device always strives to press the end piece 16 and the free end of the carrier in the upward direction in order to counteract the vertical forces which act on the coupling rod, above all by virtue of the dead

weight thereof, but also occasional, unforeseeable loads (see figs. 5 and 6). It should be particularly pointed out that said supporting function is integrated with the turnable ring so far that the carrier together with the spring device slavishly trails the coupling rod in the lateral swings thereof. In other words, the spring device does not give rise to any complicating interaction of forces between the carrier and the fastening plate 6 (or the appurtenant car body) and neither is the proper turnable ring subjected to forces of any note, which could aggravate the turning thereof around the core part 13.

As is best seen in figs. 2 and 3, two sliding plates 31 of a low-friction material are arranged on the top side of the carrier and in the area of the front end thereof, against which plates a bottom side of the coupling rod rests. More precisely, a block 33 is fixed on the bottom side of the coupling rod by means of a tightenable band 32 (see fig. 1). Said block has a planar bottom side, which abuts against and can slide backward and forward along the plates 31 without appreciable frictional resistance.

Reference is now made to figs. 7-9, which more in detail illustrate the holder mechanism built into the house 10, which mechanism has the purpose of securing the coupling rod in the neutral position thereof. The core part 13 is possible to fix on the bottom side of the main joint 4 by means of four screws 34. More precisely, said screws 34 can be tightened in the bottom part of the fixed, vertical axle 5 of the main joint. This means that also the core part 13 is fixedly or immovably arranged. However, the ring 12 is freely turnable in relation to the core part 13.

In the core part, a through bore 35 (see fig. 7) is formed, in which two slide-like bodies or pistons 36 are mounted, which are movable backward and forward in the bore and between which a spring or spring device 37 acts, which in the example consists of two sets of cup springs or Belleville spring washers. In the outer end of each individual piston 36, a pulley 38 is rotatably mounted, which forms a male member, which co-operates with a female-like

seating 39 in the inside of the turnable ring 12. More precisely, each such seating 39 is formed on the inside of a particular end plate 40, which is inserted and fixed in a side orifice 41 in the turnable ring. The seatings 39 as well as the male members or the pulleys 38 are located diametrically opposite each other. As is clearly seen in fig. 7, the two ears 24 extend perpendicularly to the imaginary vertical plane that intersects the seatings 39.

The Function and Advantages of the Invention

The coupling rod 1 is, in the neutral position thereof pointing straight ahead and shown in fig. 1, secured as a consequence of the two pulleys 38 of the holder mechanism being in engagement with the seatings 39, as is shown in fig. 7. In this state, the coupler is unconnected, i.e., passively trails the appurtenant car. Thanks to the described holder mechanism, ride may take place without the coupling rod swinging or dangling in an uncontrolled way.

When the coupler should be connected to an analogous coupler on another car and the two cars are placed on a non-straight track, the coupling rod is swung out laterally to an angle of deflection that is determined by the curve radius of the track so that coupling members 2, 3 of the respective coupler are located in flush and can be brought into engagement with each other. In the example, the swinging out takes place in a manual way against the action of the spring 37 of the holder mechanism. Namely, if a moderate, although marked lateral force is applied to the coupling rod, the spring force in the spring 37 is overcome, whereby the pulleys 38 are detached from the appurtenant seatings and can move, more precisely roll, along the inside of the ring 12. Hereupon, the spring 37 will, per se, exert a certain resistance against the turning of the ring in relation to the core part 13, but the spring force in question is linear and moderate, and not progressive and increasing with increasing angle of deflection, such as is the case in previously known couplers. In

other words, the operator can swing out the coupling rod with a moderate, conformal force to the desired setting, in which the coupling rod automatically stays and is retained thanks to the action of the spring 37 against the pulleys 38. When the coupling rod has been set in desired position, the operator may, therefore, let go of the coupling rod and remove himself/herself from the same in connection with connection being carried out.

Regardless in which rotation angle position the coupling rod is, the strong compression spring device 20 guarantees a supporting of the coupling rod, which ensures that the coupling rod always strives to assume a substantially horizontal position. However, this horizontal position is not static but may, as is outlined in fig. 6, vary in a flexible way depending on, for instance, level differences between the cars (hilly topography) and other, irrational factors of the type that is found when cars in a train unit at varying speeds are driven along railway tracks of shifting character. However, in the unconnected and normal loaded state thereof, the coupling rod is located in one and the same, substantially horizontal position.

In this connection, it should be mentioned that it is feasible to modify and/or supplement the compression spring device so that the spring characteristics thereof actively can be altered. For instance, in addition to a mechanical compression spring of the exemplified type, a pneumatic spring function may be arranged that actively can extend the spring device (i.e., the distance between the front and rear joints thereof) in order to press up the front end of the coupling rod (and the coupling members on the same) further. In such a way, the level or height of the coupling members above the railway track can be adjusted in an active way and be adapted to the level of a co-operating coupler with the purpose of, during special conditions, further facilitate the connection of two couplers.

During ride, when the respective cars alternatingly pass left-hand as well as right-hand curves, and the

coupling rods 1 are swung backward and forward around the main joint 4, the drivers 11 ensure that the carrier 9 slavishly follows the coupling rod in the motions thereof. In this connection, the spring force of the spring 37 is negligible. Even if the pulleys 38 intermittently and alternatingly pass the appurtenant seatings 39, the force in the spring 37 is far too insignificant to exert any resistance against the swings of the carrier during ride. Here it should be pointed out that the geometrical shape of the seatings 39 in no way is limited to the shape shown in figs. 7 and 8. Thus, the radius of curvature of the individual seating may be considerably larger than the one exemplified in order to facilitate roll in and roll off of the pulleys.

Feasible Modifications of the Invention

The invention is not limited only to the embodiment described above and shown in the drawings. Thus, the supporting carrier may be formed in another way than in the form of a fork. Further, the compression spring device cooperating with the carrier may be realized in many different ways, provided that that the same is extensible and has the capacity of always applying the free end of the carrier an upwardly directed spring force. The holder mechanism integrated in the securing house of the carrier may also be modified in various ways. Thus, although two male members together with two seatings are preferred, it is feasible to provide the retaining function by means of only one male member and seating, respectively. In this connection, it should also be pointed out that the invention anticipates the possibility of making the holder mechanism with an actuator, by means of which the spring-loaded male members are inactivated, i.e., are drawn into the appurtenant bore, during ride. In such a way, the risk of wear of the male members during ride would be eliminated.

List of Reference Designations

1 = coupling rod
2 = coupling member
3 = coupling member
4 = main joint (vertical)
5 = fixed joint axis
6 = fastening plate
7 = screw joint
8 = turnable ring
9 = carrier
10 = house
11 = driver
12 = turnable ring
13 = core part
14 = fork branches
14' = front branch section
14" = rear branch section
15 = joint (horizontal)
16 = end piece
17 = joint sleeve
18 = loop
19 = joint fasteners
20 = compression spring devices
21 = joint (horizontal)
22 = pivot pin
23 = loop
24 = ear
25 = bottom of end piece
26 = shank
27 = sleeve
28 = sleeve
29 = bottom of tube
30 = holder-on
31 = sliding plates
32 = tightening band
33 = sliding block
34 = screws
35 = bore
36 = pistons
37 = spring
38 = pulleys
39 = seatings
40 = end plates
41 = side orifice

Claims

1. Car coupler, comprising a coupling rod (1), which is laterally swingable by, at a rear end, being connected to a main joint (4), and which at a front, free end includes coupling members (2, 3) for connection with analogous coupling members on other car couplers, a holder mechanism (37, 38, 39) being arranged to secure the coupling rod in a non-swingable neutral position when the car coupler is inactive, c h a r a c t e r i z e d in that a bracket-like carrier (9) is arranged under the coupling rod (1), which carrier is connected to a turnable ring (12) included in a house (10) arranged under the main joint (4), in which house the holder mechanism (36, 37, 38, 39) is integrated, and that one or more drivers (11) have the purpose of forcing the carrier and the coupling rod to slavishly follow each other during lateral swinging, the coupling rod (1) resting in an axially free-flowing state on the carrier (9) so far that the coupling rod and the carrier are free to move axially backward and forward in relation to each other.

2. Car coupler according to claim 1, c h a r a c t e r i z e d in that the carrier (9) at the rear end thereof is connected to said turnable ring (12) via a first, horizontal joint (15) in order to be able to swing in a vertical plane, and that a compressable compression spring device (20) extends between a front portion of the carrier and a second joint (21) located on a level below the first joint (15) in order to, by leverage from below, strive to press up the coupling rod against the action of vertical force loads on the same.

3. Car coupler according to claim 2, c h a r a c t e r i z e d in that the carrier consists of a fork (9) having two branches (14), the rear ends of which are articulately connected to the turnable ring (12) via said first joint (15), and the front ends of which are stiffly united to a

common end piece (16) to which a front end (26) of the compression spring device (20) is articulately connected.

4. Car coupler according to claim 3, c h a r a c t e r i z e d in that the fork branches (14) are angular by including, on one hand, front sections (14'), which are substantially parallel to the compression spring device (20) and located beside the same, and on the other hand two rear sections (14"), which extend upward/rearward from the front branch sections at an obtuse angle to the same.

5. Car coupler according to any one of the preceding claims, c h a r a c t e r i z e d in that two side plates (11) are attached on the carrier (9) and which are laterally spaced-apart and axially distanced from the rear joint (15), between which side plates the coupling rod (1) is located, and which serve as drivers between the carrier and the coupling rod.

6. Car coupler according to any one of the preceding claims, c h a r a c t e r i z e d in that sliding plates (31) of a low-friction material are arranged on the carrier (9), against which plates a part (33) of the coupling rod (1) rests.

7. Car coupler according to any one of the preceding claims, c h a r a c t e r i z e d in that the house (10) to which the rear end of the carrier (9) is connected, in addition to said turnable ring (12), includes a central core part (13), which is stiffly connected to a fixed axle (5) included in the main joint (4), and that the holder mechanism comprises a spring-loaded male member (38) mounted in the core part (13), which male member is arranged to co-operate with a seating (39) on the inside of the turnable ring (12), more precisely in such a way that the turnable ring, on one hand, retains the carrier (9) together with the coupling rod (1) in the neutral position as long as the male member (38) is in engagement with the

seating (39), and on the other hand enables swinging of the coupling rod when the male member – against said spring action – has been brought out of engagement with the seating.

8. Car coupler according to claim 7, c h a r a c t e r-i z e d in that the turnable ring (12) comprises two diametrically opposed seatings (39) and the core part (13) two diametrically opposed male members (38), which are spring-loaded by a common compression spring (37) arranged in a bore (35) in which the male members are movable backward and forward.

9. Car coupler according to claim 7 or 8, c h a r a c-t e r i z e d in that the individual male member consists of a rotatable pulley (38).

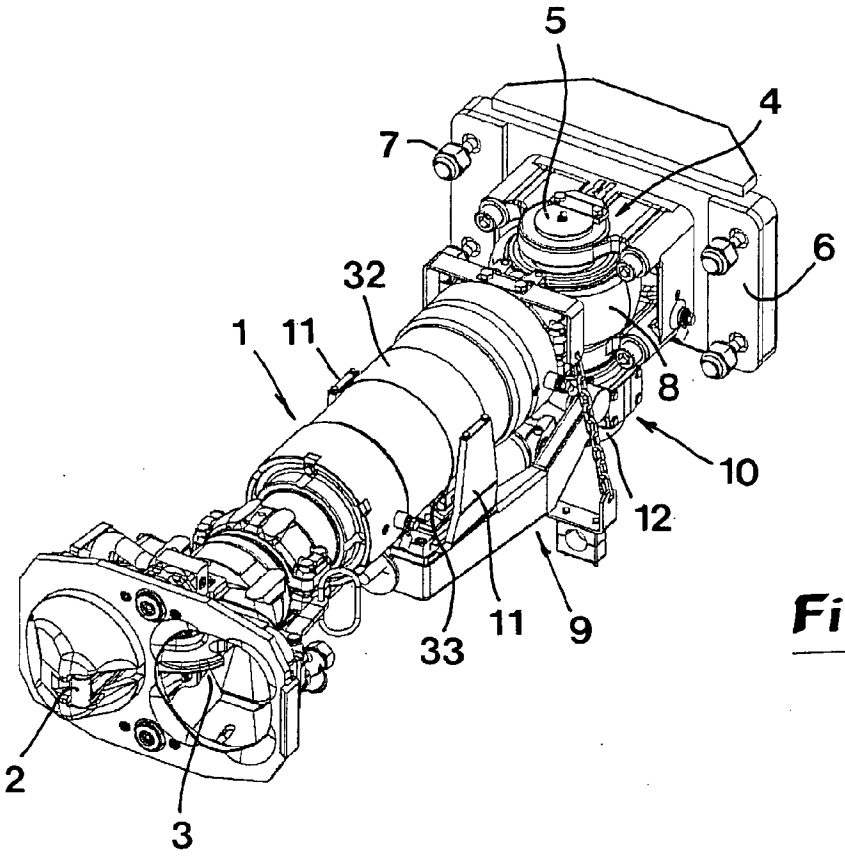
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Fig 1

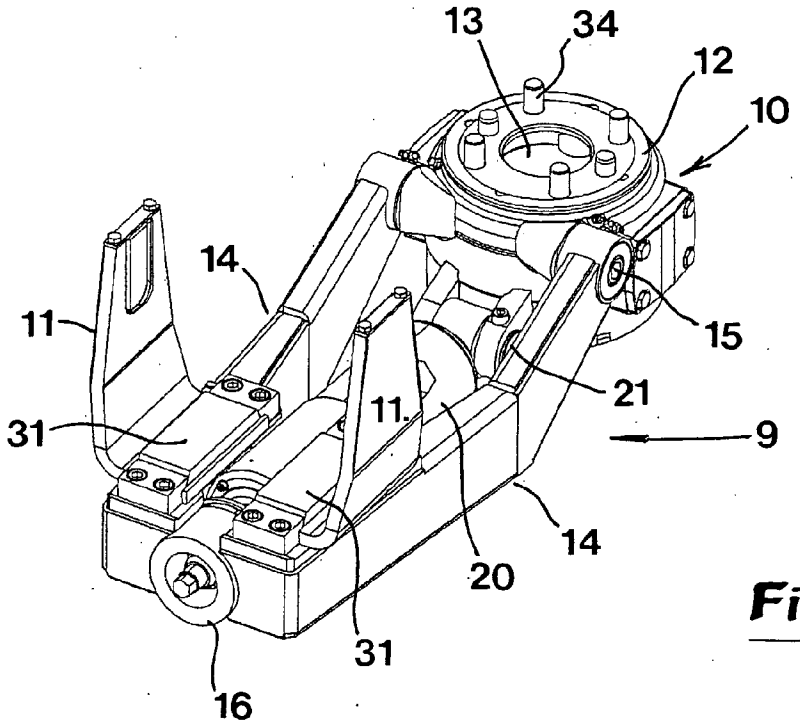
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Fig 2

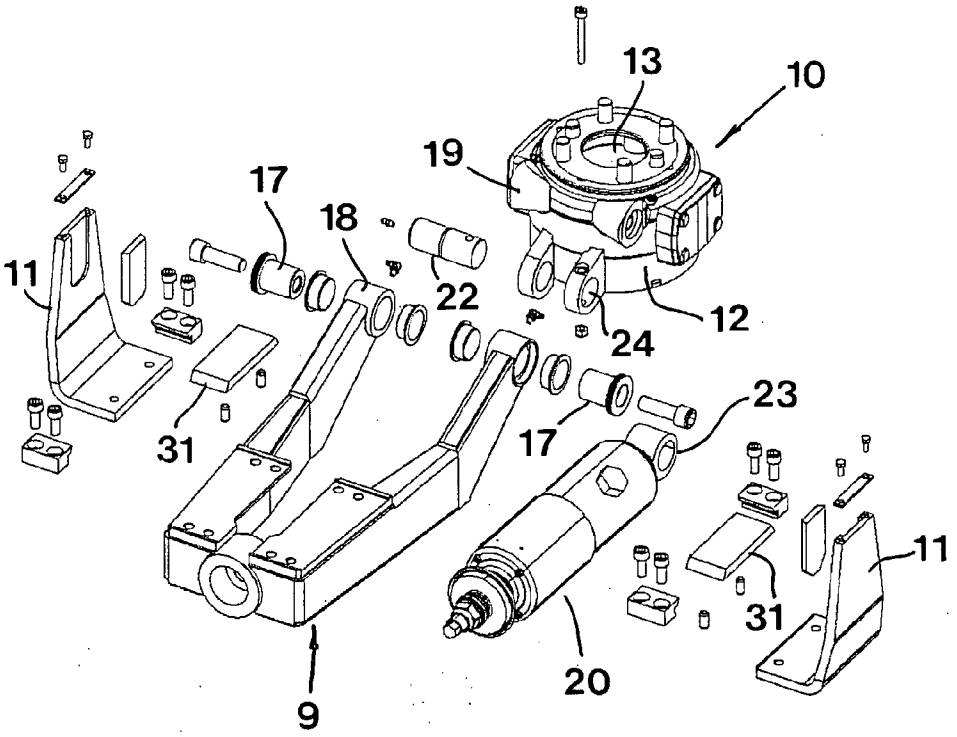
13
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Fig 3

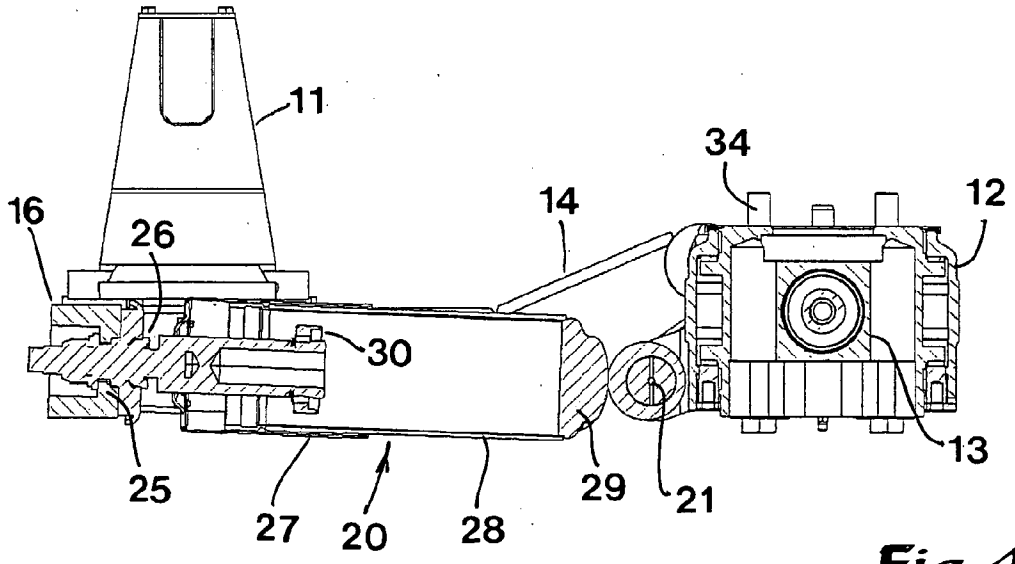
11
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Fig 4

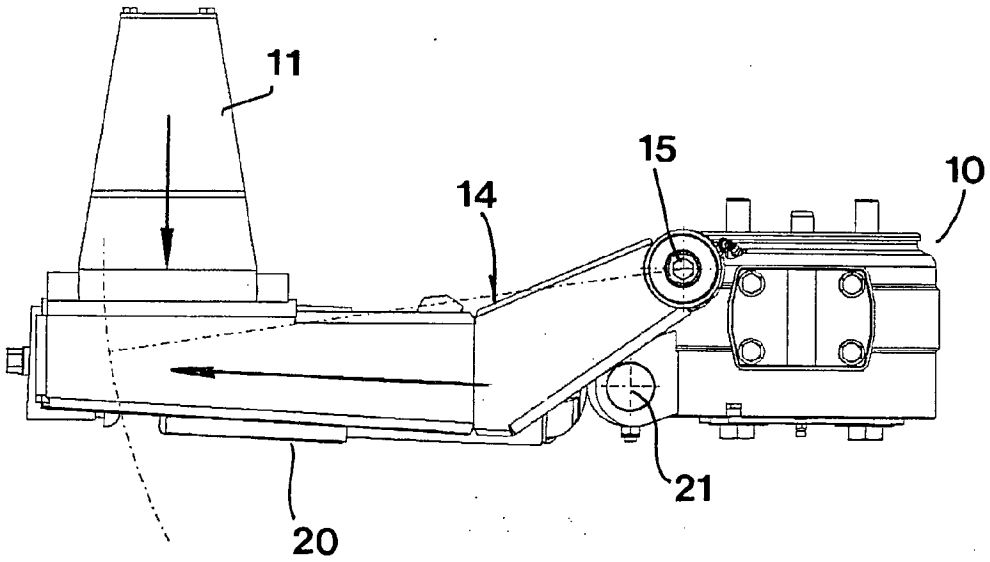

Fig 5

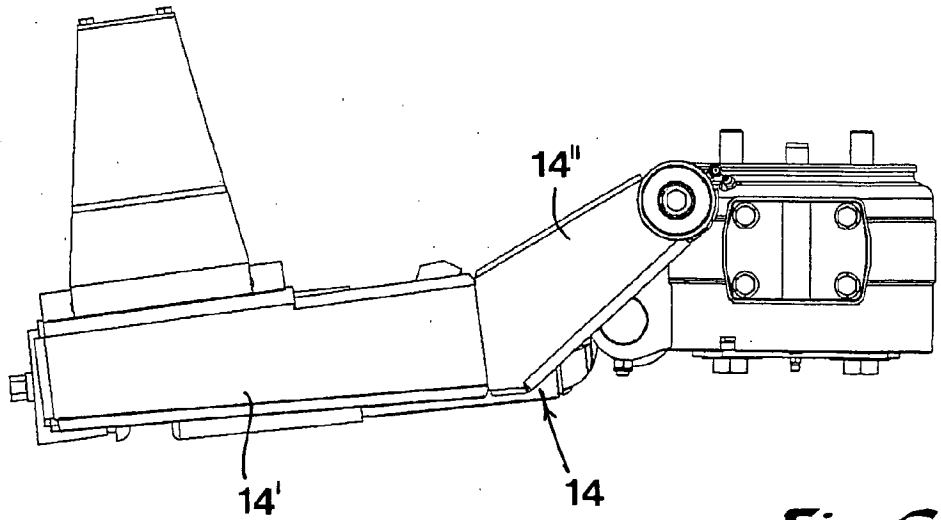

Fig 6

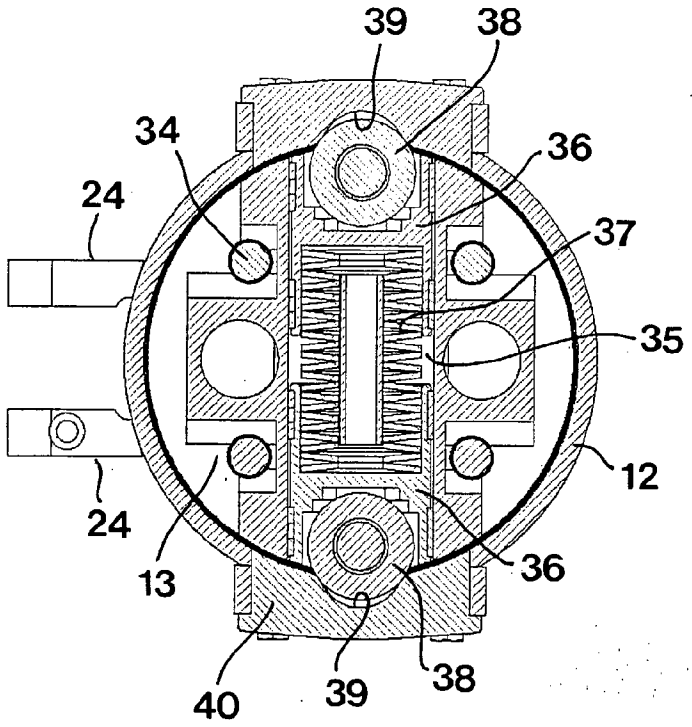

Fig 7

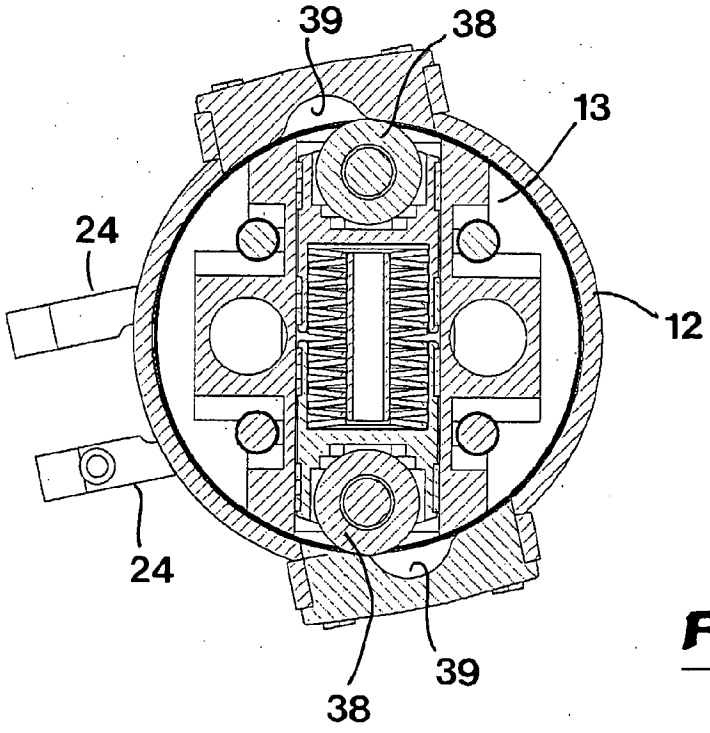

Fig 8

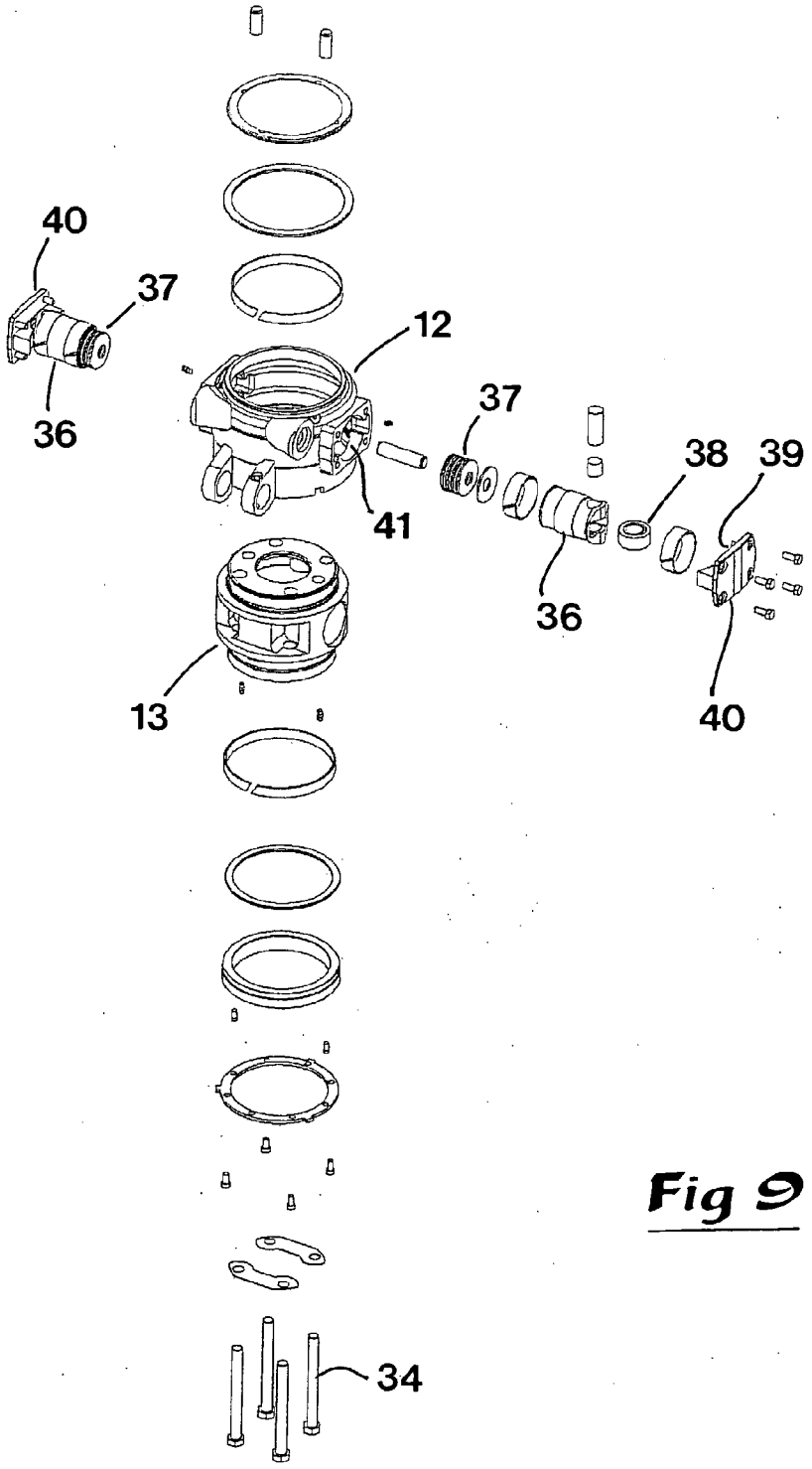

Fig 9

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 2004/001354

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: B61G 7/10
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: B61G

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-INTERNAL, WPI DATA, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4049129 A (BERGS), 20 Sept 1977 (20.09.1977)	1-9
	--	
A	EP 0583604 A1 (SCHARFENBERGKUPPLUNG GMBH), 23 February 1994 (23.02.1994)	1-9
	--	
A	EP 0608531 A1 (DELLNER COUPLERS AB), 3 August 1994 (03.08.1994)	1-9
	--	
A	EP 1057708 A1 (KNORR-BREMSE), 6 December 2000 (06.12.2000)	1-9
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☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
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"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
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"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
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Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Christer Jönsson/EK Telephone No. +46 8 782 25 00

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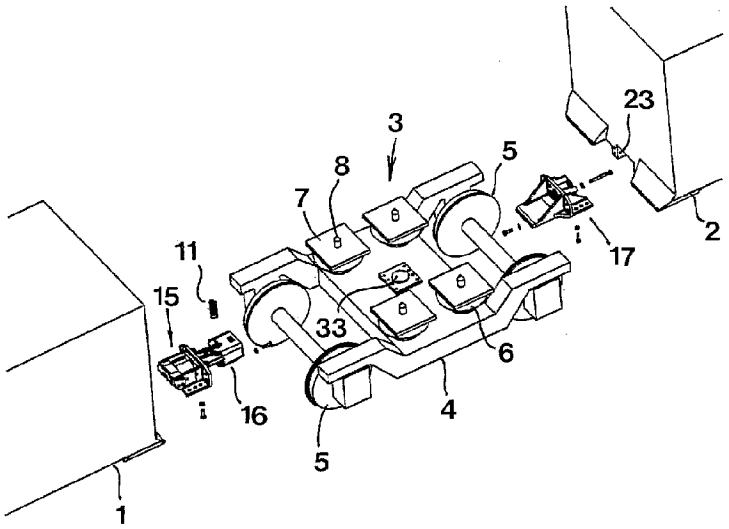
[Continued on next page]

(54) Title: RAIL-MOUNTED CAR HAVING AN ARTICULATED JOINT FOR PERMANENTLY CONNECTING TWO UNDERBODIES OF THE RAIL-MOUNTED CAR



(57) Abstract: In one aspect, the invention relates to a link device for permanently connecting two chassis (1, 2) included in a rail-mounted car, which chassis are turnably connected to each other via a hinge (11). A first link member is partable by being composed of two parts (16, 17) releasably connected to each other, namely a first part (16) connected to the hinge (11) and a second part (17) that is fastenable on one of the chassis (2), and the second link member (15) being fastenable on the other chassis (1), the releasable joint between said link parts (16, 17) having the purpose of enabling separation of the chassis from each other without the hinge being removed. In another aspect, the invention also relates to a rail-mounted car comprising such a link device or link coupling.

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SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— *with international search report*

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RAIL-MOUNTED CAR HAVING AN ARTICULATED JOINT FOR PERMANENTLY CONNECTING TWO UNDERBODIES OF THE RAIL-MOUNTED CAR

Technical Field of the Invention

In one aspect, this invention relates to a rail-mounted car that comprises two chassis, which are permanently connected via a link device, which comprises two link members connected to a chassis each, which members are turnably connected to each other via a hinge.

In another aspect, the invention relates to a link device as such intended for permanently connecting two car chassis.

Description of the Prior Art

Link devices or link couplings for permanently connecting two chassis or car bodies included in a rail-mounted car or railroad car are richly described in the patent literature. See, for instance, US-A-2 051 958, US-A-3 667 820, DE-A-1 094 289, DE-AS-1 605 188, DE-19638763A1, DE-4121080A1, DE-10153460A1, FR-A-2 398 651, EP-A-0279245, EP-A-0343482, EP0771710A1 and EP1312527B1.

The hinge that connects the two link members in couplings of the kind in question has the purpose of, between the link members, transferring intermittent tensile, compressive and torsion stresses of the type that arise under all the conditions that occur in driving train units at low as well as high speeds, i.e., allowing all types of translations and rotations irrespective of these acting in the longitudinal, lateral or vertical direction, e.g., upon cornering and in driving in hilly topography, respectively. For this reason, the hinge has to be made with a vertical pin in order to enable horizontal turning laterally, as well as a more sophisticated, spherical bearing in which an elastic impact- and vibration-absorbing body (elastomer body) is included, and which can absorb the translations and rotations of the link members.

Such link couplings are permanent in the sense that they essentially have the purpose of permanently holding together

two or more wheel-carried chassis or car bodies that together form an individual car, which in turn may be connected to and disconnected from other cars. Thus, during normal circumstances, the chassis in one and the same car are permanently connected to each other. However, every now and then, need arises for separating the chassis of the car from each other, e.g., in connection with repairs and maintenance and upon transportation to final customer.

It is common for previously known link couplings that they in practice only enable separation and renewed connection, respectively, of the chassis by dismounting and remounting, respectively, of the hinge between the two link members. However, this is a delicate work and difficult to carry out because the hinge includes a plurality of components, which in particular upon renewed connection has to be brought together with high accuracy; something which is complicated, time-consuming and ergonomically trying because the proper link members as well as the different hinge components are extraordinary heavy. The work is made more difficult if the chassis of the car would not be set up on an ideally horizontal ground.

Theoretically, it is feasible, per se, to dismount or release the fixing of one of the link members against the appurtenant chassis. However, in practice, this alternative is even more difficult to carry out and at times entirely impossible for reasons of construction and space.

Objects and Features of the Invention

The present invention aims at obviating the above-mentioned drawbacks of previously known link couplings and at providing an improved link coupling or link device, as well as a rail-mounted car having improved possibilities of separating and again connecting two chassis included in the car. Thus, a primary object of the invention is to provide a link coupling that enables disconnection and connection, respectively, of two chassis included in a car without having to dismount and remount, respectively, the hinge between the two link members of the coupling, or dismounting and remounting, respectively, anyone of the fixings of the link members against a chassis;

all with the purpose of enabling a quick and simple disconnection and connection, respectively, of two car chassis, e.g., in connection with intermittently occurring repair and maintenance work.

According to the invention, the above-mentioned object is attained by the features defined in the characteristic parts of the independent claims 1 and 5, respectively. 5. Preferred embodiments of the car and the link device, respectively, according to the invention are furthermore defined in the dependent claims.

Summary of the Invention

The invention is based on the idea to make one of the two link members of the link coupling partable by constructing the same from two parts releasably connected to each other, namely a first part, which may be permanently connected to the hinge, and a second part, which is fastenable on one of the chassis, wherein the second link member can be allowed to be permanently fastened on the other chassis. Separation of the chassis may then be carried out by removing dismountable connecting elements, e.g., screws, which normally hold together the two parts of the partable link member. Advantageously, one part of the partable link member may be of a male-like character and insertable in a female-like seating in the second part. In such a way, the two chassis of the car may be brought together without major demand on precision in connection with reconnection. Although it is feasible, per se, to apply the invention in connection with such cars that include two independently wheel-carried chassis or car bodies, i.e., chassis that individually are carried by two pairs of wheel or wheel bogies, the same is particularly suitable for use in cars of the type that includes a so-called Jakobs bogie, i.e., a bogie that simultaneously carries ends of chassis facing each other, which chassis have own wheels or wheel bogies only at the opposite ends thereof.

Brief Description of the Appended drawings

In the drawings:

Fig. 1 is a simplified, perspective exploded view showing parts of two chassis or bodies included in a car, and a centrally placed Jakobs bogie carrying the same, as well as parts of a link coupling according to the invention, all objects being shown regarded obliquely from above,

Fig. 2 is an enlarged perspective view of a link arrangement belonging to the left chassis in fig. 1,

Fig. 3 is corresponding perspective view of a link arrangement belonging to the right chassis in fig. 1,

Fig. 4 is an exploded view corresponding to fig. 1 and showing the chassis and the Jakobs bogie obliquely from below,

Fig. 5 is an exploded view corresponding to fig. 2 and showing said link arrangement obliquely from below,

Fig. 6 is a perspective view corresponding to fig. 3 and showing the same link arrangement obliquely from below,

Fig. 7 is an enlarged, partial longitudinal section through the link coupling according to the invention in assembled state,

Fig. 8 is a perspective and additionally enlarged exploded view showing the arrangement according to fig. 2 more in detail,

Fig. 9 is a perspective exploded view illustrating a collision protection included in the arrangement according to fig. 8, and

Fig. 10 is an enlarged longitudinal section showing a detail included in said collision protection.

Detailed Description of a Preferred Embodiment of the Invention

In figs. 1 and 4, numerals 1, 2 designate parts of two chassis or car bodies, which together form a rail-mounted car for railway traffic. At the visible ends thereof facing each other, the two chassis are carried by a common Jakobs bogie generally designated 3, while the same chassis at the non-visible ends thereof are carried by own wheels or wheel bogies. In a conventional way, the schematically shown Jakobs bogie 3 includes a framework 4 and at least two pairs of

wheels 5 and shock absorption means in the form of four elastic cushions 6 arranged in pairs and applied under assembling plates 7, which can be fixed underneath the individual chassis. The joint between the assembling plates 7 and the individual car chassis is outlined by means of male elements or pins 8 on the top sides of the plates and downward open seatings or holes 9 on the bottom sides of the chassis.

Reference is now made to fig. 7, which in longitudinal section illustrates an assembled link coupling according to the invention. This link coupling is generally designated 10 and includes two link members, which are interconnected via a hinge in its entirety designated 11, which in the previously described way includes a vertical pin 12, which enables turning of the link members in relation to each other in the horizontal direction, as well as a partly spherical bearing box 13 (so-called elastomer bearing), which enables rotary motions and oscillatory motions in the vertical direction between the link members. The vertical, geometrical axis of the pivot pin 12 is designated C. A first link member 14, which is connected to the chassis 2, is situated to the right of the hinge 11 in fig. 7, while a second link member 15, which is connected to the chassis 1, is situated to the left of the hinge 11. At the ends thereof turned away from each other, said link members 14, 15 are permanently fixed at the respective chassis in so far that they after initial mounting on the chassis should not need to be removed even in connection with repairs and maintenance. However, it should be pointed out that the link members are not welded to the chassis, but rather connected to the same via releasable connecting elements, which enable exchange of the link members, e.g., after emergence of serious damage on the same or the chassis.

In accordance with the invention, one of the two link members 14, 15, namely. the first link member 14, is partable by being composed of two parts releasably connected to each other, namely a first part 16, which is permanently connected to the second link member 15 via the hinge 11 (see figs. 2 and 5), and a second part 17 (see figs. 3 and 6), which is permanently connected to the chassis 2. Among the applicant's

designers, the part 16 is denominated "bearing bracket", while the part 17 popularly is denominated "shelf". More concrete, the first link part 16 is of a male-like character and insertable in a female-like seating in the second link part 17.

As is seen in figs. 3 and 6, the link part 17 is composed of a bottom plate 18, an upright transverse end plate 19, and two vertical side pieces or side plates 20, which are stiffly united to the end plate 19 as well as the bottom plate 18, preferably by being welded against the same. Thus, between the side pieces, an upward as well as forward open seating or space is defined in which the bearing bracket 16 can be received. In the backward direction from the end plate, two fastening plates 21 extend to which two longitudinal, vertical guide plates 22 are stiffly united. Said last-mentioned plates may be inserted between two blocks 23 protruding downward from the bottom side of the chassis and being of a type that is standard on car chassis of the kind in question. The blocks 23 are located in the area between the two support surfaces 24, which rest against the assembling plates 7 of the Jakobs bogie. Together, the plates 18-22 (see fig. 3) form a shelf-like frame that is form-stiff and capable of sustaining weight. In the rearward protruding fastening plates 21, holes 25 are recessed for dismountable fastening or locking elements 26, e.g., screws, by means of which the fastening plates may be fixed against the bottom sides of the blocks 23. In an analogous way, holes 27 are formed in the end wall 19 for horizontal screws or fastening elements 28, which may be tightened in holes in the front surfaces of the blocks 23. In the part of the end plate 19 that extends between the side pieces 20, additional holes 29 are formed, which are through and co-operate with sleeves 30, which extend in the direction axially rearward from the end plate. By means of said sleeves 30, comparatively long bolts or screws 31 may be guided inward towards the holes 29 and be inserted through the same in order to be tightened in threaded holes 32 in the end surface of the link part or of the bearing bracket 16 (see fig. 5).

In this connection, it should be pointed out that in the area axially behind the blocks 23 together with the abutment surfaces 24, there is a fairly well sized space for the operator that has the task of mounting and dismounting, respectively, the screws 31. Therefore, the work of, on one hand, connecting the two link parts 16, 17 to each other (by application of the screws 31), and on the other hand separating the same (by dismounting the screws 31), does not present any considerable difficulties in ergonomical respect.

In order to centre the Jakobs bogie and the hinge 11 in relation to each other – in the case such a bogie is included in the car – two co-operating centring devices are arranged, namely a first device 33 on the framework 4 of the bogie and a second device 34 (see fig. 6), which is included in the link part 17. In the example, the first centring device 33 is in the form of a protruding male element having a rotationally symmetrical basic shape, while the device 34 consists of a downwardly opening, analogously shaped seating in which the male element 33 engages. As is seen in fig. 7, the seating 33 is formed in the bottom side of the bottom plate 18 the link part 17, the pivot pin 12 not having contact with the centring devices. However, in the assembled state of the link coupling, the link part 16 is stiffly united to the link part 17 (by means of the screws 31), the construction being so formed that the pivot pin 12 and the male element 33 automatically are centred in relation to the geometrical centre axis C when the link part 16 assumes correct position in relation to the link part 17.

In fig. 8, it is seen how the second link member 15 includes a front link head 35 and a rear carrier generally fixedly connectable to an appurtenant chassis and designated 36. Like the shelf-like link part 17, said carrier includes one or two bottom plates 37 and a vertical plate 38 in the form of a front plate from which two vertical side pieces 39 extend, which are stiffly united to the front plate as well as the bottom plate. The side pieces are oriented perpendicularly to the front plate and mutually spaced-apart, at the same time as they separately are located at a certain distance inside

the opposite side edges of the bottom plate 37. In practice, the frame 36 (as well as the frame 17) is made from a strong steel plate, e.g., having a thickness within the range of 25-50 mm. A back piece 40 included in the carrier is even stronger, which piece advantageously can be made in the form of a solid cast iron body, which is connected to the side pieces 39 of the frame 36 via one or more strong connecting elements 41, e.g., thick bolts or pins. In analogy with the link part 17, the frame 36 may be connected to the appurtenant chassis by means of bolts that are tightened in the block 23 of the chassis via holes 25, 27.

Reference is now made to figs. 9 and 10, which more in detail illustrate the nature of the link member 15. In fig. 9, it is seen that the link head 35 at a rear end has a cross piece 42, which extends perpendicularly to the geometrical longitudinal axis of the link head. More precisely, the cross piece 42 is of a rectangular basic shape, grooves 43 being recessed in the opposite short side edges thereof. In the mounted state, the link head 35 projects through a central opening 44 in the front plate 38 of the frame 36, the cross piece abutting against the back side of the front plate. In the cross piece 42, four threaded holes 45 are formed for receipt of equally many screws or bolts 46 (see fig. 10), which have the purpose of holding the link head in place. In the area between the male thread and head of the individual screw, the shank of the screw is somewhat weakened via a waist 47, the diameter of which decides the strength of the screw. By endowing the waist 47 a suitable diameter, it may be predetermined at which stress the screw should break. If the link coupling in its entirety would be exposed to extreme, axial impulsive forces of the type that may arise in connection with collisions, accordingly the link head 35 may be detached from the frame 36 by the fact that the screws 46 break, and then be set in an axial, translational motion in the backward direction.

On the inside of the individual side piece 39, an axially oriented guide bar 48 is arranged, which engages a cooperating groove 43 in the cross piece 42 of the link head.

Upon translational move of the link head in relation to the frame, accordingly the link head is guided by the bars 48.

In the shown, preferred embodiment of the link coupling, a collision protection is integrated in the link member 15, which in the example is in the form of three tubes or sleeves 49, 50, namely a central tube 49 of a first type, and two co-lateral tubes 50 of another type. All tubes are deformable and co-operate with through bores 51, 52 formed in the back piece 40, which bores have a smaller diameter than the appurtenant tube. As is clearly seen in fig. 9, the intermediate deformation tube 49 together with the appurtenant bore 51 has a larger diameter than the two co-lateral tubes 50 and the bores 52 thereof. Although the bores 50, 51 have different diameters, the same are formed in principally the same way. See in this respect fig. 10, which shows a thin deformation tube 50 together with the appurtenant bore 52. In this bore, a funnel-like, conical mouth 53 is formed, which widens in the forward direction. The deformation tube 50 is of a cylindrical basic shape, but has at the rear end thereof a conical tapering portion 54, which is inserted into the conical mouth 53. In this position, the tube is kept in place by means of a holder in its entirety designated 55. The mouth 53 and the conical portion 54 of the tube has one and the same conicity or cone angle. Said cone angle should amount to at least 5° and at most 20°, and suitably be within the range of 10-16°. Tests that form the basis of the invention have been most successful when the cone angles have varied within the range of 11-15°.

At the opposite, front end 56 thereof, the deformation tube 50 is distanced from the cross piece 42 of the link head via a gap 57. The tube end 56 may advantageously consist of a planar, ring-shaped surface, which extends perpendicularly to the geometrical longitudinal axis of the tube. The axial extension of the gap 57 may be within the range of 10-20 mm. In this connection, it should be pointed out that the corresponding gap of the intermediate deformation tube 49 may have another, for instance smaller, axial extension than the gap 57 of each thin deformation tube 50. For instance, the corresponding gap length of the tube 49 may be within the range of

5-15 mm. By the fact that the gaps are of different sizes, the different deformation tubes will be impinged by the cross piece 42 at different points of time.

Here, it should be pointed out that the collision protection shown in figs. 8-10 and briefly described is the subject of a simultaneously filed Swedish patent application having the denomination "COLLISION PROTECTION IN A COUPLER FOR RAIL-MOUNTED VEHICLES AND A COUPLER EQUIPPED THEREWITH FOR PERMANENTLY CONNECTING TWO RAIL-MOUNTED VEHICLE UNITS". In the same patent application, the collision protection is described more in detail. Briefly, it should, however, be mentioned that the screws 46 upon a strong collision break, whereby the link head 35 is detached and can move in the direction of the back piece 40. In doing so, the cross piece 42 impinges on the deformation tubes 49, 50, which will be pressed into the appurtenant bore 51, 52 in the back piece up to a point where the cross piece is stopped against the back piece. When the individual tube is pressed into the appurtenant bore, the same will be deformed successively by being compressed or pressed together in the radial direction, while the outer diameter of the tube is reduced to the same inner diameter as the smallest diameter of the cone mouth 53. During this deformation work, the kinetic energy in the detached link head is converted into heat in the deformation tubes as well as the back piece. This means that a substantial part of the kinetic energy is extincted before it has time to be transferred from one of the car chassis to the other.

The Function and Advantages of the Link Coupling According to the Invention

When the two chassis or car bodies 1, 2 is to be assembled while forming a usable car, in a first step the link part 17 is mounted on one of the chassis 2 and the link member 15, with the ensuing link part 16, on the other chassis 1. Fixation of the shelf and box-like frames 36, 17, respectively, is carried out in the above described way by means of screws or bolts 26, 28, which are tightened in threaded holes in the blocks 23 of the chassis. In the next step, the end of the

chassis 2 not equipped with wheels is lifted in above the Jakobs bogie 3 and is located in a position in which the male elements 8 can be brought to engagement with the seatings 9 at the same time as the centring devices 33, 34 engage each other. When this has taken place, also the end of the other chassis 1 not equipped with wheels is lifted in above the Jakobs bogie and is lowered down so that the male-like link part or bearing bracket 16 is located in the female-like seating that is delimited by the bottom plate, end plate and side pieces of the link part 17. Vertical lowering of the link part 16 into said seating is possible as a consequence of the seating being open upward. In a final step, the link parts 16, 17 are fixed in relation to each other by means of the screws 31.

During normal circumstances, the described link coupling in co-operation with the Jakobs bogie guarantee a permanent keeping together of the two chassis. However, would a need arise for separating the chassis from each other, this can be carried out by means of the simple measure of dismounting the screws 31 and remove the chassis from the Jakobs bogie in the opposite order.

A fundamental advantage of the invention is that two chassis included in a car can be connected and disconnected without any need for manipulating the hinge between the link members of the link coupling. Neither the more or less theoretical possibility of removing a link member from the appurtenant chassis needs to be resorted to.

Feasible Modifications of the Invention

The invention is not limited only to the embodiment described above and shown in the drawings. Thus, the invention is applicable also to such link devices or link couplings that lack collision protection. It is also feasible to apply the invention to such link couplings that do not co-operate with any Jakobs bogie. Thus, the link coupling can also be used for such cars the chassis of which are separately wheel-carried at the two ends thereof.

List of Reference Designations

1	Chassis
2	Chassis
3	Jakobs bogie
4	Framework
5	Wheels
6	Damping cushions
7	Assembling plates
8	Male element
9	Seatings
10	Link coupling
11	Hinge
12	Pivot pin
13	Bearing box
14	First link member
15	Second link member
16	First link part
17	Second link part
18	Bottom plate
19	End plate
20	Side pieces
21	Fastening plates
22	Guide plates
23	Blocks
24	Support surfaces
25	Screw hole
26	Screws
27	Screw hole
28	Screws
29	Via hole
30	Sleeves
31	Screws
32	Screw hole
33	Lower centring device
34	Upper centring device
35	Link head
38	Front plate
39	Side pieces
40	Back pieces
41	Fixing screws
42	Cross piece
43	Guiding groove
44	Opening
45	Screw hole
46	Screws
47	Waist
48	Guide bar
49	Intermediate deformation tube
50	Lateral deformation tube
51	Bore
52	Bore
53	Coned mouth
54	Cone tip
55	Holder
56	Tube end
57	Gap

36 Carrier
37 Bottom plate

Claims

1. Rail-mounted car comprising two chassis (1, 2), which are permanently connected via a link device (10), which comprises two link members (14, 15) connected to a chassis each, which members are turnably connected to each other via a hinge (11), c h a r a c t e r i z e d in that a first, partable link member (14) is composed of two parts (16, 17) releasably connected to each other, namely a first part (16) connected to the hinge (11) and a second part (17), which is fastened on one of the chassis (2), and the second link member (15) being fastened on the other chassis (1), the chassis being, if required, separable by the fact that the joint between said two link parts (16, 17) is broken.

2. Car according to claim 1, c h a r a c t e r i z e d in that the first part (16) of the partable link member (14) is of a male-like character and inserted into a female-like seating in the second part (17), and fixed therein by means of dismountable connecting elements (31).

3. Car according to claim 1 or 2, comprising a Jakobs bogie (3) arranged between the chassis (1, 2), which bogie has the purpose of jointly carrying the ends of the chassis facing each other and being connected via the link device (16), and which in addition to a framework (4), at least two pairs of wheels (5) and damping means (6), includes a device (33) located under the hinge (11) for centring of the bogie in relation to the hinge, c h a r a c t e r i z e d in that the centring device (33) is in engagement with an analogous, second centring device (34), which is arranged on the second part (17) of the partable link member (14), while the second link member (15) lacks directly connection to the bogie.

4. Car according to claim 2 or 3, c h a r a c t e r i z e d in that the second link part consists of a shelf-like frame (17), which is composed of a bottom plate (18), an upright end plate (19) and two vertical side pieces (20), which project in the

forward direction from the end plate and are stiffly united to the same as well as the bottom plate, and that one or more fastening plates (21) extend rearward from the end plate (19) for connection and fixation of the frame against the appurtenant chassis (2).

5. Link device for permanently connecting two chassis (1, 2) included in a rail-mounted car, comprising two link members (14, 15) connectable to a chassis each, which members are turnably connected to each other via a hinge (11), c h a r a c t e r i z e d in that a first link member (14) is partable by being composed of two parts (16, 17) releasably connected to each other, namely a first part (16) connected to the hinge (11) and a second part (17), which is fastenable on one of the chassis (2), and the second link member (15) being fastenable on the other chassis (1), the releasable joint between said link parts (16, 17) having the purpose of enabling separation of the chassis from each other.

6. Link device according to claim 5, c h a r a c t e r i z e d in that the first part (16) of the partable link member (14) is of a male-like character and inserted into a female-like seating in the second part (17) and fixed therein by means of dismountable connecting elements (31).

7. Link device according to claim 6, c h a r a c t e r i z e d in that said second link part consists of a shelf-like frame (17) composed of a bottom plate (18), an upright end plate (19) and two vertical side pieces (20), which project in the forward direction from the end plate and are stiffly united to the same as well as the bottom plate while defining said seating, one or more fastening plates (21) extending rearward from the end plate (19) for connection to a chassis (2).

8. Link device according to claim 6 and 7, c h a r a c t e r i z e d in that in the end plate (19) a number of through holes (29) are formed adjacent to which there are sleeves (30) extending rearward for said connecting elements (31).

9. Link device according to claim 7 or 8, c h a r a c t e r i z e d in that the bottom plate (18) of the frame (17) includes a centring device (33) for co-operation with an analogous centring device (34) on a Jakobs bogie (3).

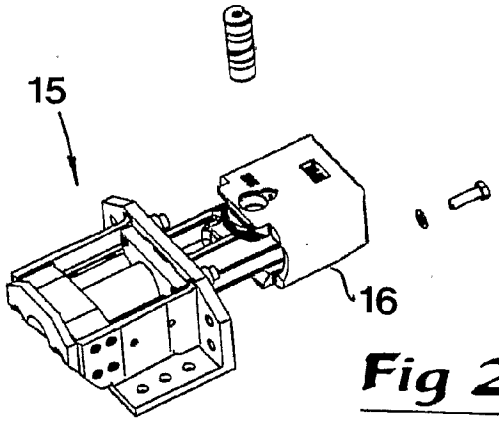

Fig 2

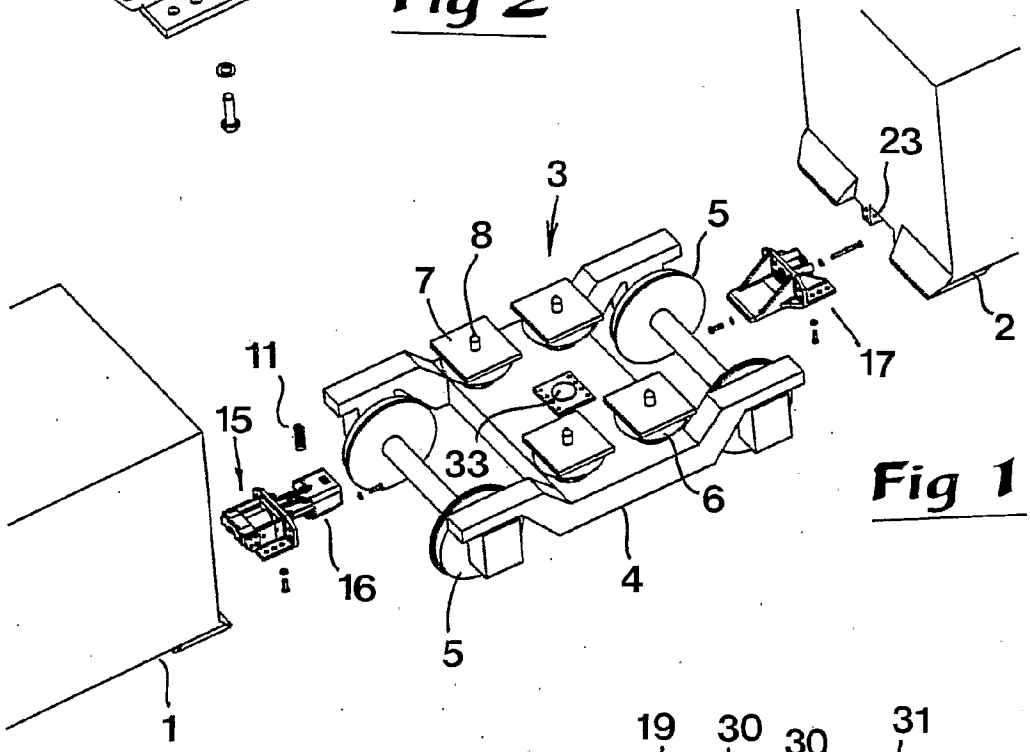

Fig 1

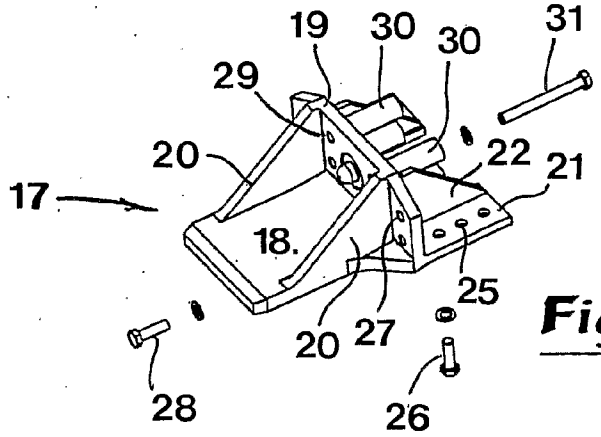

Fig 3

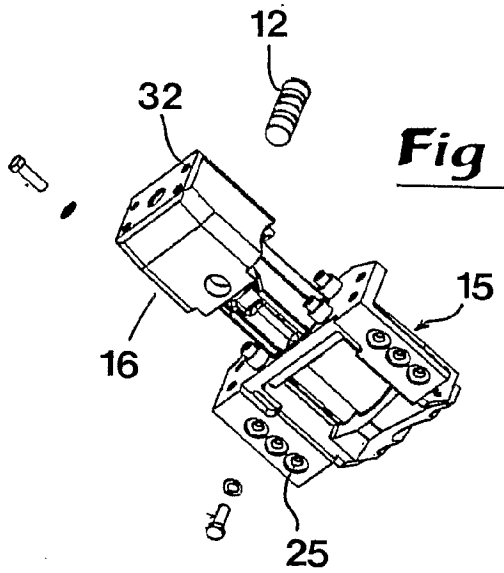

Fig 5

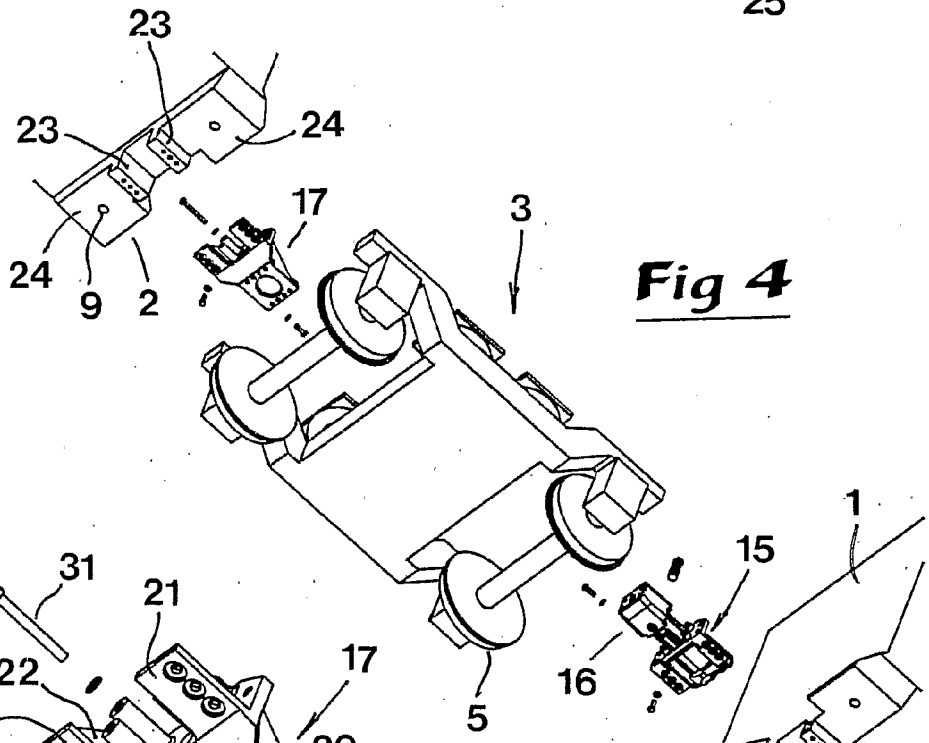

Fig 4

Fig 6

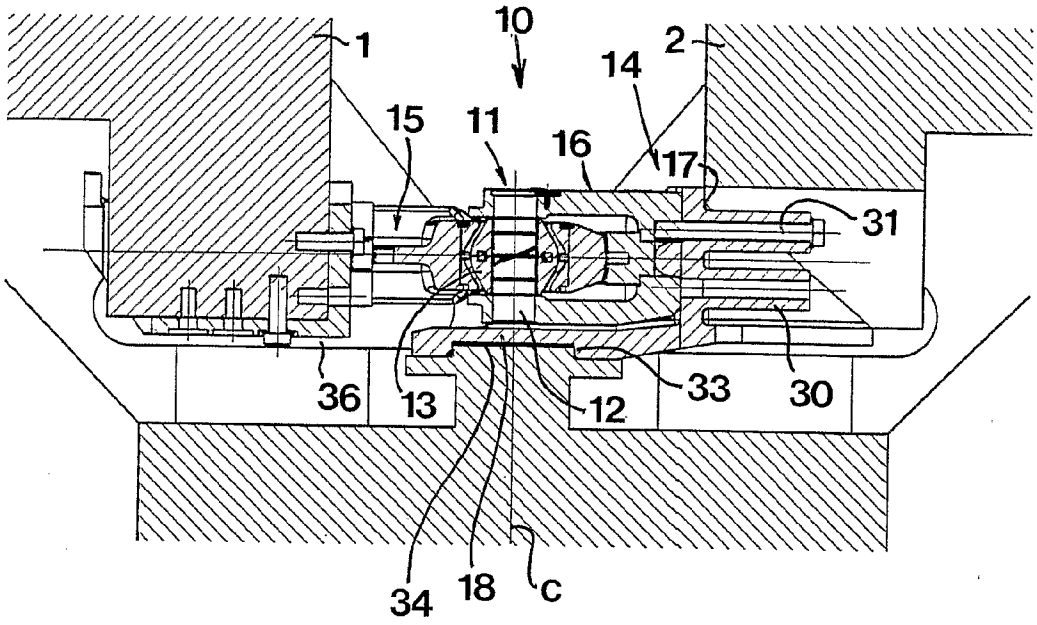
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Fig 7

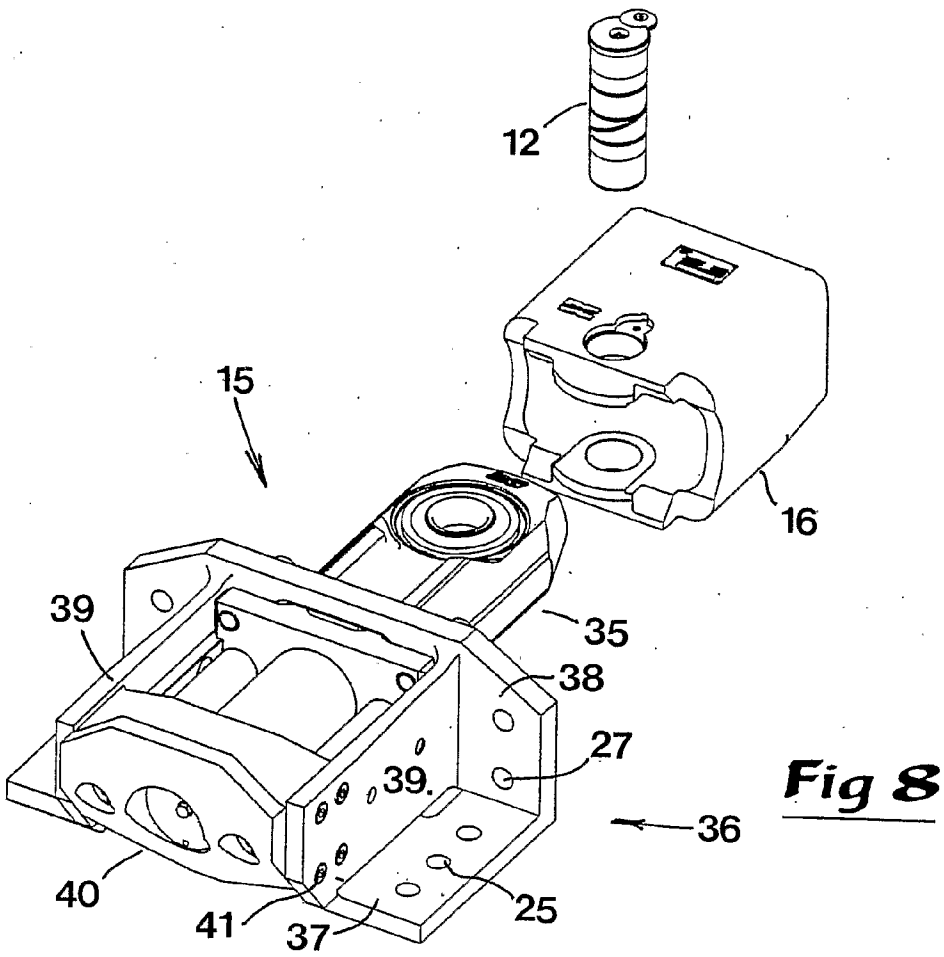
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Fig 8

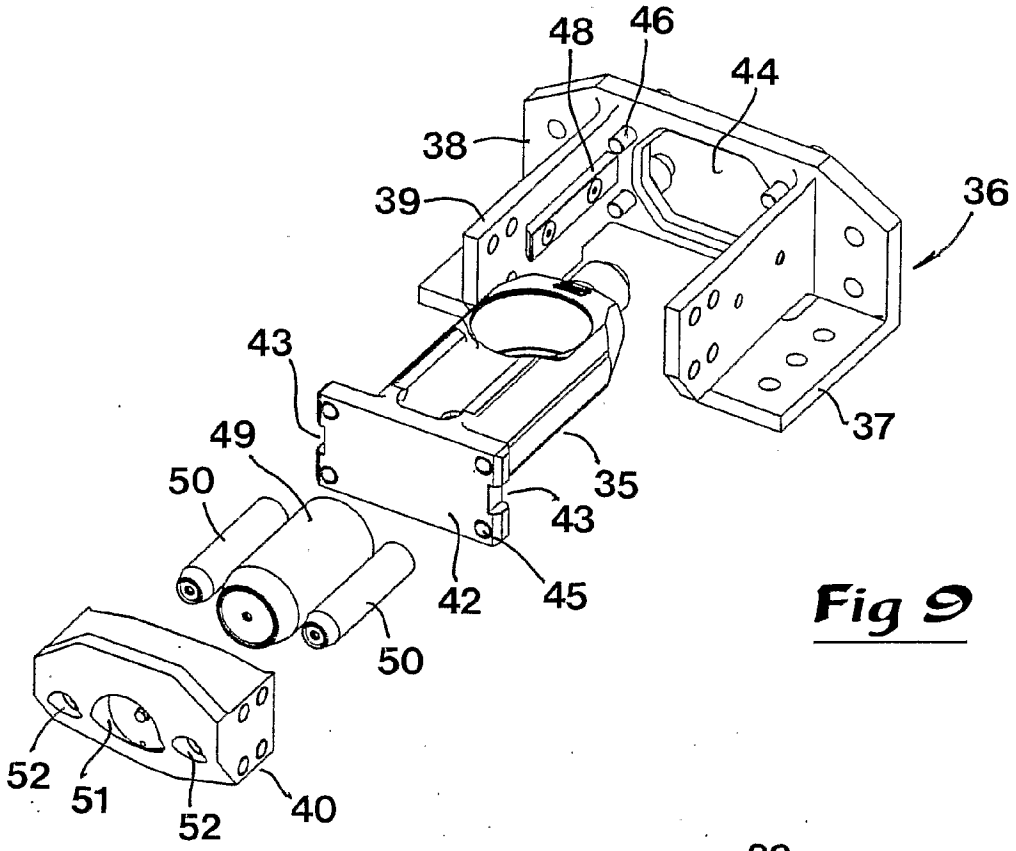
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Fig 9

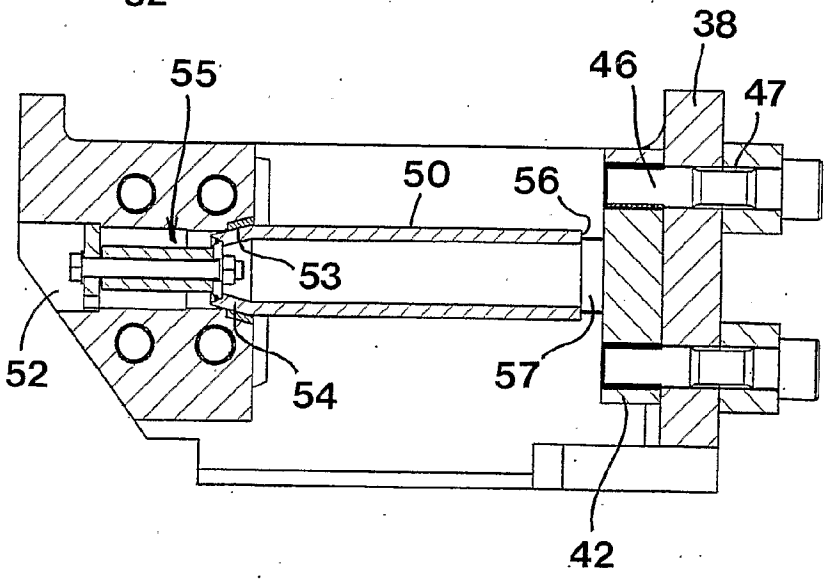
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Fig 10

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 2004/001256

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: B61G 5/02, B61F 3/12
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: B61G, B61F, B61D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-INTERNAL, WPI DATA, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 1312527 A1 (VOITH TURBO SCHARFENBERG GMBH & CO), 21 May 2003 (21.05.2003) --	1-9
A	DE 10153460 A1 (VOITH TURBO SCHARFENBERG GMBH & CO KG), 22 May 2003 (22.05.2003) --	1-9
A	US 4962861 A (WIEBE), 16 October 1990 (16.10.1990) -- --------	1-9

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
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"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
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"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
10 December 2004	15 -12- 2004
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Christer Jönsson/EK Telephone No. +46 8 782 25 00

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				DE	20121562	U	02/01/2003
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Published:
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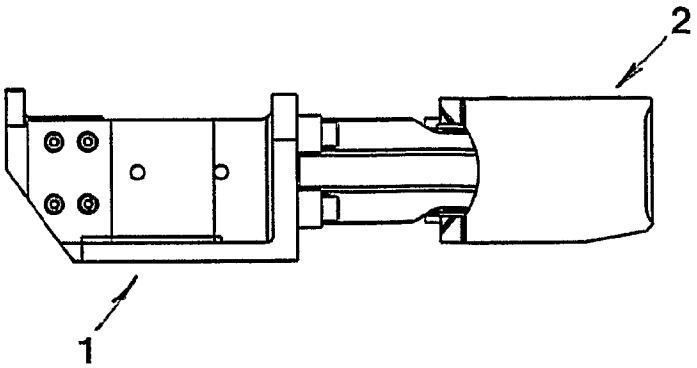
For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: COLLISION PROTECTION IN A COUPLER FOR RAIL-MOUNTED VEHICLES, AND A COUPLER EQUIPPED THEREWITH FOR PERMANENTLY CONNECTING TWO RAIL-MOUNTED VEHICLE UNITS



(57) Abstract: The invention relates to a collision protection for couplings the rail-mounted vehicles of the type that comprises a coupling element (1) in which two parts (6, 7) translationally movable in relation to each other are included, between which one or more energy-extincting elements (23, 24) of deformable character are arranged. Characteristic of the invention is that the energy-extinction elements (23, 24) consist of tubes, which are deformable by radial compression as a consequence of having a first, tapering end portion inserted into a thinner bore (25, 26) in one of the parts (7) and an opposite, free end distanced from the second part (6) in order to, upon displacement of the two parts (6, 7) in the direction of each other, be pressed axially into the bores. The invention is particularly suitable for use in link devices of the type that is used for permanently connecting two rail-mounted vehicle units.

WO 2005/023618 A1

COLLISION PROTECTION IN A COUPLER FOR RAIL-MOUNTED VEHICLES, AND A COUPLER EQUIPPED THEREWITH FOR PERMANENTLY CONNECTING TWO RAIL-MOUNTED VEHICLE UNITS

Technical Field of the Invention

In a first, broad aspect, this invention relates to a collision protection for couplings for rail-mounted vehicles of the type that comprises a coupling element in which two parts translationally movable in relation to each other are included, between which at least one energy-extincting or energy-absorbing element of deformable character is arranged.

In a second, more limited aspect, the invention relates to a link device intended for permanently connecting two rail-mounted vehicle units of the type that comprises two link members connected via a common hinge, one of which is divided into two parts translationally movable in relation to each other, namely a front link head connected to the hinge and a rear carrier fixedly connectable to a vehicle unit, between said parts an energy-extincting or energy-absorbing element of deformable character serving as collision protection being arranged.

Already now it should be pointed out that the collision protection henceforth treated constitutes a protection in the sense that the same has the purpose of protecting the rail-mounted vehicles in question against plastic deformation upon moderate collisions, the energy that is absorbed in the collision protection included in the coupling only constituting a part of all energy that is absorbed by the total collision protection equipment of the rail-mounted vehicle (comprising, for instance, deformation zones in the vehicles) upon larger collisions.

Description of the Prior Art

A collision protection and a link device of the above generally mentioned kind is previously known by EP 1312527. In this case, the energy-extincting element consists of a plastically deformable tube, which at a rear end is fixedly

united to the rear carrier of the individual link member and which at a front end co-operates with a mandrel-like male element (in the form of a more robust tube) that projects rearward from the link head connected to the hinge. More precisely, said deformation tube is at the front end thereof formed with a conical collar widening forwards, in which a partially conically shaped ring on the rear end of the male element is inserted. More precisely, the conical surface on said ring is pressed in close contact with or free from play against the collar of the deformation tube already in the starting position of the device, i.e., without collision having occurred. When an axial force in excess of a predetermined limit value is applied to the individual link member, the male element is allowed to penetrate axially into the deformation tube during radial expansion of the same, the material in the tube being deformed plastically under simultaneous heat release; all with the purpose of transforming kinetic energy to heat energy and thereby abate or reducing the effect of axial impulsive forces between two connected rail-mounted vehicle units.

However, in practice, this type of collision protection is associated with a plurality of disadvantages. One disadvantage is caused by the deformation work and the transformation of energy taking place by radial expansion of the deformation tube so far that this requires a certain available space around the tube. In such a way, the possibilities of the designer to attain desired compactness of the link device in its entirety are limited. Furthermore, the fact that the deformation takes place by radial expansion entails a latent risk that the material in the deformation tube breaks before the male element has had time to run the entire length of stroke thereof. In such a way, the energy transformation process may cease prematurely, whereby the effect of the collision protection of the tube is lost too fast. In addition, the general energy-absorbing capacity of the construction is fairly limited also in the case the tube does not break.

Objects and Features of the Invention

In the broadest aspect thereof, the present invention aims at obviating the disadvantages of previously known collision protections in general and at providing an improved collision protection. Thus, a primary object of the invention is to provide a collision protection, which can be realized in a compact embodiment by not requiring any particular space of receipt of radially expanding components. An additional object is to provide a collision protection, the energy-extinction elements of which do not risk breaking and which, therefore, do not risk prematurely losing the energy-converting and shock-absorbing capacity thereof.

According to the invention, at least the primary object is attained by the features that are defined in the characterizing clause of claim 1. Preferred embodiments of the collision protection according to the invention are furthermore defined in the dependent claims 2-15.

In a second, more limited aspect, the invention also relates to a link device of the type initially mentioned. The features of this link device is seen in the characterizing clause of claim 16.

Summary of the Invention

The invention is based on the idea of using one or more tubes or sleeves as energy-extinction elements, which tubes or sleeves are plastically deformable by radial compression such as a consequence of they having a first, tapering end portion inserted into a thinner bore in one of the two parts of a coupling element and an opposite, free end distanced from the second part in order to, upon displacement of the two parts in the direction of each other - in connection with a collision accident - be pressed axially into the bore. This means that the deformable element never can become enlarged radially and occupy space in the surroundings outside the same. Neither it is risked that the element breaks prematurely because of material break.

Another feature characteristic of the invention is that the front, free end of the deformation tube or tubes is distanced from one part of the coupling element via a certain gap. In such a way, it is guaranteed that the deformation tube never can be influenced by the normal, moderate stresses that occur in the link device. Not until such considerable impulsive forces that occur in connection with collisions or the like have detached the translationally movable part, this will contact the deformation tube and trigger the collision protection function.

Brief Description of the Appended drawings

In the drawings:

Fig. 1 is a side view of a link device intended for permanent coupling and in which a collision protection according to the invention is included,

Fig. 2 is a planar view from above of the link device according to fig. 1,

Fig. 3 is a longitudinal section through the same link device,

Fig. 4 is a perspective exploded view of two link members included in the link device,

Fig. 5 is a perspective exploded view of only one of the link members,

Fig. 6 is an enlarged longitudinal section through a carrier included in the link member,

Fig. 7 is a first longitudinal section through a back piece included in the carrier,

Fig. 8 is a second longitudinal section through the same back piece,

Fig. 9 is a side view of first type of deformation tube included in the collision protection,

Fig. 10 is a longitudinal section through the same tube,

Fig. 11 is a side view of another type of deformation tube,

Fig. 12 is a longitudinal section through the tube according to fig. 11, and

Fig. 13 is a simplified, perspective exploded view showing the link device adjacent to two rail-mounted vehi-

cle units in the form of chassis or car bodies, as well as a Jakobs bogie co-operating with the same.

Detailed Description of a Preferred Embodiment of the Invention

Below, the invention will be described, reference being made to a particular form of coupling for rail-mounted vehicles, namely a link device or link coupling, which in practice is used for permanently connecting two rail-mounted vehicle units, e.g., two wheel-carried chassis or car bodies, which together form a railroad car, which can be inserted into arbitrary train units by being connected with other cars or locomotives, usually via automatic couplers or the like. However, it should already now be pointed out that the invention is not limited to a link device of the type that is shown in the drawings, but rather may also be applied to arbitrary coupling elements in order to interconnect rail-mounted vehicles, e.g., automatic couplers, other permanent couplers or the like.

The link device selected as embodiment example and illustrated in figs. 1-4 includes two components, namely a first, complete link member 1 and a part designated 2, which is included in a second link member. More precisely, the part 2 is insertable into a box-like frame 2', shown in fig. 13, which forms a second link part that is fastenable on another vehicle unit or car body than the link member 1. The two link members are mutually articulately connected via a hinge in its entirety designated 3. In a conventional way, this hinge includes a vertical pin 4, which enables the link members 1, 2 to turn in relation to each other in the horizontal plane, as is outlined by means of the angle range α in fig. 2, as well as a spherical bearing box 5, which allows that the link members turn in the vertical plane in relation to each other, as is outlined by means of the angle range β in fig. 3. Each link member 1, 2 is fastenable on a rail-mounted vehicle unit or a chassis, as is outlined in fig. 13. In the example, only one of the link members, namely the link member 1, is formed with a

collision protection according to the invention, and therefore the second link member 2, 2' will not be described closer.

As is best seen in fig. 4 in combination with figs. 1-3, the link member 1 includes a front link head 6 and a rear carrier, fixedly connectable to a co-operating vehicle unit, which carrier in its entirety is designated 7. In the example, said carrier is composed of two assembled components, namely a box-like frame 8, as well as a back piece 9 located in the area of the rear end thereof. The frame 8 includes a bottom plate 10, as well as a vertical front plate 11 from which two vertical side pieces 12 extend, which are stiffly united to the front plate as well as the bottom plate, e.g., by being welded against the same. The side pieces are oriented perpendicularly to the front plate 11 and spaced-apart mutually, at the same time as they separately are located at a certain distance inside the opposite side edges of the bottom plate 10. In practice, the frame 8 is made from a strong steel plate (thickness within the range of 25-50 mm). The back piece 9 is even more robust, which advantageously can be made in the form of a solid cast steel body, which is connected to the side pieces 12 of the frame 8 via a plurality of strong connecting elements 13, e.g., large screws or pins. Connection of the carrier 7 to the appurtenant rail-mounted vehicle unit takes place via the bottom and front plates 10, 11 of the frame 8, more precisely via connecting elements, not shown, that are applied in holes 14 in the respective plates.

Reference is now made to figs. 5 and 6, which more in detail illustrate the nature of the link member 1. In fig. 5, it is seen that the link head 6 at a rear end has a cross piece 15, which extends perpendicularly to the geometrical longitudinal axis of the link head. More precisely, the cross piece 15 is of a rectangular basic shape, grooves 16 being recessed in the opposite short side edges thereof. In mounted state, the link head 6 projects through a central opening 17 in the front plate 11 of the frame 8, the cross piece 15 abutting against the back side of the

front plate 11. In the cross piece 15, four threaded holes 18 are formed for receipt of equally many screws or bolts 19 (see fig. 6), which have the purpose of holding the link head in place. In the area between the male thread and head 20 of the individual screw, the shank of the screw is somewhat weakened via a waist 21, the diameter of which decides the strength of the screw. By endowing the waist 21 a suitable diameter, it may be predetermined at which stress the screw should break. If the link device would be exposed to extreme, axial impulsive forces of the type that arise in connection with collisions and the like, accordingly the link head 6 can be detached from the frame 8 by the fact that the screws 19 break, and then be set in an axial, translational motion in relation to the frame.

On the inside of the individual side piece 12, an axially oriented guide bar 22 is arranged, which engages a co-operating groove 16 in the cross piece 15 of the link head. Thus, upon translational move of the link head in relation to the frame, the link head is guided by the guide bars 22.

With the back piece 9, three tubes or sleeves serving as collision protection are connected, namely a central tube 23 of a first type, and two co-lateral tubes 24 of another type. The nature of these tubes, which in practice are denominated deformation tubes, will be described closer below, reference being made to figs. 9-12. The most conspicuous difference between the two types of tubes is that they have different diameters. More precisely, the intermediate tube 23 has a larger diameter than the two side tubes 24. The tubes co-operate with through bores 25, 26 in the back piece 9.

Reference is now made to figs. 7 and 8, which illustrate the nature of the above-mentioned bores 25, 26 of the deformation tubes 23, 24. Although the intermediate bore 25 of the central deformation tube 23 and the co-lateral bores 26 of the tubes 24 have different diameters, they are formed in principally the same way. Thus, the individual bore is of a cylindrical basic shape and is formed with a

funnel-like mouth 27, which widens in the forward direction towards the front surface 28 of the back piece 9. In the example, each bore is divided into three different sections having different diameters, namely a front section 29, which has a smallest diameter and is located in close vicinity of the mouth 27, an intermediate section 30 having a somewhat larger diameter, and a rear section 31, which has a larger diameter than the intermediate section 30. Between the two last-mentioned sections, a ring-shaped shoulder surface 32 is formed. In this case, the shape of the mouth 27 is genuinely conical, i.e., the surface defining the mouth is rotationally symmetrical and generated by a rectilinear generatrix. In this connection, it should, however, be pointed out that the shape of the funnel mouth 27 tapering in the backward direction also may be defined by other surfaces than a genuinely conical one, e.g., a convexly curved surface (= the generatrix being arched).

In fig. 6, a particular insert ring 33 is shown, which is not shown in figs. 7 and 8, but which after manufacture of the body forming the back piece 9, is mounted in the ring-shaped space adjacent to the bore. Said insert ring 33 consists of another material than the material in the rest of the back piece. For instance, the ring 33 may be composed of a high-strength and heat-resistant steel, while the body 9, for instance, consists of cast steel.

A common feature of the two types of tubes 23, 24 (see figs. 9-12) is that the same have a first, rear end portion 34, which tapers in the backward direction from the long, front portion 35 of the tube. In the example, the portion 35, which extends along the major part of the length L of the tube, has a genuinely cylindrical shape, i.e., the envelope surface 36 thereof is cylindrical and generated by a conceived rectilinear generatrix that is parallel to the centre axis C (see figs. 11, 12). The tapering shape of the end portion 34 is determined by an external envelope surface 37, which in the example is genuinely conical, i.e., generated by a conceived generatrix

that is rectilinear. In the example, the conical end portion 34 has the same thickness T as the cylindrical portion 35, more precisely as a consequence of the internal surface 38 of the end portion 34 having the same conicity as the external surface 37. The same conicity, which is determined by angle γ, is of great importance for the serviceability of the deformation tube. In the example, the angle γ amounts to 15°. Although the conicity may vary upward as well as downward from this value, the cone angle in question should, however, amount to at least 5° and at most 20°, and suitably be within the range of 10-16°. Tests that form the basis of the invention have been most successful when the cone angles have varied within the range of 11-15°. In this connection, it should be emphasized that it is the cone angle of the external envelope surface 37 that is most critical. Accordingly, adaptation and variation of the energy-absorbing capacity of the deformation tube to desired characteristics may be effected by varying the wall thickness in the end portion 34. Thus, by decreasing the cone angle of the internal surface 38, the end portion 34 may successively become thinner in the backward direction towards the smallest opening of the tube.

The wall thickness of the cylindrical tube portion 35 is defined as $D_1-D_2/2$, where D_1 is the outer diameter and D_2 the inner diameter. In the example, the tube 24 of the thinner type has an outer diameter D_1 of 60 mm and an inner diameter D_2 of 42 mm, i.e., the wall thickness amounts to 9,0 mm. Simultaneously, the total length L is 249 mm. In this connection, it should be pointed out that the front end of the tube 24 is constituted by a ring-shaped, planar surface 39, which extends perpendicularly to the centre axis C.

At the rear end thereof, the tube 24 has a seating in which a washer 40 having a nut 41 is welded.

The differences between the embodiment described above and shown in figs. 8 and 9 and the thicker tube 23 shown in figs. 10 and 11 are few. However, the outer diameter D_1 of the tube 23 is larger and amounts in the example

to 134 mm, at the same time as the inner diameter D_2 amounts to 120,2 mm, i.e., in this case the wall thickness of the tube amounts to 6,9 mm (to compare with the thickness of 9,0 mm of the thinner tube 24). When a plurality of tubes having different diameters are used in combination with each other, it has turned out that the wall thickness of the sleeves should be in inverse proportion to the diameter so far that a thicker tube should have a smaller wall thickness than any thinner tube and vice versa.

The total length L of the thick tube 23 amounts to 266 mm. In other words, the tube 23 is somewhat longer than the tube 24.

In other respects, the tube 23 resembles the tube 24 so far that it includes a welded washer 40 and a nut 41, and the conical end portion 34 having the same wall thickness 1 as the cylindrical portion 35.

Now reference is made again to figs. 7 and 8, which – in the concrete embodiment example – illustrate the dimensions of the bores 25, 26 that co-operate with the deformation tubes 23, 24. For the thick bore 25, it applies that the inner diameter D_3 of the section 29 amounts to 120 mm. This dimension agrees with the smallest inner diameter of the insert ring 33 (see fig. 6) at the rear end of the ring. As has been pointed out above, the deformation tube 23 has an outer diameter D_1 of 134 mm. This means that the diameter of the hole section 29 amounts to only approx. 90 % of the outer diameter of the tube and that the outer diameter of the tube will be reduced by 14 mm when the tube is pressed into the bore.

As to the rest, the diameter D_4 of the intermediate section 30 is 122 mm, while the rear section 31 has a diameter D_5 of 127 mm. The axial length L_1 of the back piece amounts to 160 mm. As to the rest, the length dimensions are L_2 95 mm, L_3 45 mm and L_4 26 mm. The largest outer diameter D_6 of the mouth 27 amounts to 146 mm.

The cone angle λ agrees with the cone angle γ according to fig. 12 (the complementary mounted insert ring 33 is

of uniform thickness and has, therefore, the same cone angle as the seating of the mouth).

For the thinner bore 26 according to fig. 8, the following vital dimensions apply: D_3 = 52 mm, D_4 = 54 mm, L_2 = 105 mm, L_3 = 45 mm, L_4 = 18 mm and D_6 = 72 mm. Also in this case, the cone angle λ agrees with the cone angle γ of the tube 24.

From the above, it is seen that the inner diameter D_3 (52 mm) of the hole section 29 amounts to approx. 87 % of the outer diameter D_1 (60 mm) of the tube 24. Thus, in this case, the diameter of the tube 24 is reduced by 8 mm upon deformation. Generally, the degree of reduction should be within the range of 80–95 %, suitably 85–90 %.

Now reference is made again to fig. 6, which illustrates how a deformation tube 24 is mounted in the back piece 9. More precisely, the mounting is carried out by means of a bolt 42 provided with a head 42', the male thread of which bolt is screwed into the female thread of the nut 41. The head 42' is tightened against a stopping element in the form of a washer 43, which is pressed against the aforementioned shoulder 32. Between the washers 40, 43 serving as stopping elements, a spacer member 44 extends, the length of which decides the tightening force by which the conical end portion of the tube 24 is fastened in the mouth or the seating 27 in the back piece 9.

Reference is now made to fig. 2, in which is seen that the tubes 23, 24 protrude differently far in the forward direction from the back piece 9. More precisely, the thick, central tube 23 protrudes somewhat longer than the two thinner, co-lateral tubes 24. Between the tube 23 and the cross piece 15 of the link head 6, a gap 45 is accordingly formed, which is somewhat smaller or founder than the gaps 46 between the front end surfaces 39 of the side tubes 24 and said cross piece 15. In practice, the gap 45 may have an axial length within the range of 5–15 mm and the gaps 46 a length within the range of 10–20 mm. This means that one of the tubes, namely the central tube 23 will be impinged by the cross piece 15 somewhat before the same

cross piece impinges on the other tubes in connection with a possible triggering of the collision protection.

The choice of material in the deformation tubes 23, 24 is of vital importance. Generally, the tubes should be made from steel, more precisely carbon steel. After a plurality of tests, it has turned out that a commercially available steel of the type OVAKO 280 has particularly suitable properties. This steel is characterized by the following principal analysis: C: 0,17-0,20 %, Si: 0,30-0,45 %, Mn: 1,45-1,60 %, P: max 0,030 %, S: 0,020-0,035 %, Cr: 0,202-0,30 %, Ni: max 0,30 %, Mo: max 0,10 %, Cu: max 0,30 %, V: 0,08-0,12 %, Ca: max 15 ppm, Ti: max 30 ppm, O: max 15 ppm and N: 70-150 ppm.

The Function and Advantages of the Invention

During normal circumstances, i.e., when the cars or the vehicle units in a train unit are exposed to usual tensile, compressive and torsion stresses, the collision protection formed by the three deformation tubes is inactive so far that the screws 19 hold the link head 6 fixed in the position shown in the drawings in which the cross piece 15 is kept pressed in close contact against the back side of the front plate 11. In this state, the cross piece has no contact at all with the deformation tubes 23, 24 because of the presence of the gaps 45, 46. However, if a collision would occur and the cars or the vehicle units are applied extreme impulsive forces, which aim to propagate through a train unit, the collision protection is activated. This takes place by the screws 19 breaking, whereby the link head 6 is detached so that the same and the back piece may move towards each other. In doing so, the cross piece 15 first impinges on the central tube 23 and shortly afterwards the two thinner side tubes 24, wherein all tubes will be pressed into the appurtenant bore in the back piece up to a point where the cross piece 15 is stopped against the front surface 28 of the back piece 9. When the individual tube is pressed into the appurtenant bore, the same will be deformed successively by being compressed or pressed

together in the radial direction while the outer diameter of the tube is reduced to the same inner diameter as the front section 29 in the bore (= the smallest inner diameter of the insert ring). During this deformation, which in all essentials takes place in the area of the conical insert ring 33, the kinetic energy in the detached link head is converted into heat in the deformation tubes as well as the back piece 9. This means that a substantial part of the kinetic energy is extincted before it is transferred from one of the cars or vehicle units to the other.

The above-mentioned screws 19 extend axially, i.e., parallel to the length extension of the link member or parallel to the direction of the relative motion between the link head 6 and the frame 7. Therefore, rupture takes place by the material in the screws, more precisely the waists of the screws, attaining the ultimate tensile strength. In this connection, the screws serve as triggering members, which - by suitable choice of the diameter of the screws or the waists - can be dimensioned so that they activate the collision protection at a very exact, predetermined limit value of the impulsive forces that the link coupling should carry. In addition to this, the screws also contribute in the shock-absorbing and kinetic energy-extincting work so far that the material in the same is deformed under strain and heat release up to the point where the ultimate tensile strength is attained. In this connection, it should also be mentioned that the strain of the screws is possible as a consequence of the presence of the gaps 45, 46 between the cross piece 15 of the link head and the free ends of the deformation tubes 23, 24, i.e., as a consequence of the deformation tubes not being clamped at the opposite ends thereof. The fact that the screws are stretched and extended a distance before they break also means that the cross piece 15 of the link head is in the immediate vicinity of the ends of the deformation tubes (the gap 45 between the deformation tube 23 and the cross piece 15 is reduced to some or a few millimetres) when the screws break and trigger the proper collision protection. Furthermore, the

prestress of the screws 19 gives a joint free of play and fatigue resistant to normal vertical, lateral and longitudinal operational loads. Furthermore, in this connection, it should be pointed out that the link head and the cross piece thereof are guided axially without being angularly displaced thanks to the guide bars 22 engaging in the guiding grooves 16.

Although it would be feasible to use only one deformation tube that can be pressed together radially, it is preferred to use two or more differently long tubes in which the deformation work is initiated differently far after the link head having been released from the locked position thereof. In such a way, a more even energy-extinction course is obtained. Furthermore, the use of a plurality of tubes having limited diameter instead of one single tube having a large diameter means an improved utilization of the available height space in the link device or the coupling. In other words, for a given specification of requirements, a collision protection from a plurality of co-lateral deformation tubes occupies a considerably smaller space in the vertical direction than a single tube for the same specification of requirements.

By modifying the deformation forces of the triggering screws 19 and of the tubes 23, 24 and combine these in a suitable way, a progressive course of forces can be achieved during the entire impact upon a collision.

Feasible Modifications of the Invention

The invention is not solely limited to the embodiment described and shown in the drawings. As already previously has been pointed out, the general inventive idea may accordingly be applied in any couplings for rail-going vehicles, e.g., in automatic couplers or permanent couplers of a type that does not form link devices of the permanent type described above. Entering into details, the collision protection may be modified in various ways, in particular regarding the geometry of the deformation tubes and the receiving bores. Thus, the tapering portion on the deforma-

tion tube does not necessarily need to have a genuinely conical shape, neither the receiving, tapering mouth.

List of Reference Designations

1 = link member
2 = link part
2' = link part
3 = hinge
4 = pivot pin
5 = bearing box
6 = link head
7 = carrier
8 = frame
9 = back piece
10 = bottom plate
11 = front plate
12 = side pieces
13 = connecting elements
14 = hole
15 = cross piece
16 = guiding grooves
17 = opening
18 = hole
19 = screws
20 = screw head
21 = waist
22 = guide bar
23 = intermediate deformation tube
24 = co-lateral deformation tubes
25 = bore
26 = bore
27 = bore mouth
28 = front surface
29 = front bore section
30 = intermediate bore section
31 = rear bore section
32 = shoulder surface
33 = insert ring
34 = conical tube end portion
35 = main tube portion
36 = tube envelope surface
38 = internal cone surface
39 = planar tube end surface
40 = washer
41 = nut
42 = bolt
43 = washer
44 = spacer member
45 = gap
46 = gap

37 = conical envelope surface

Claims

1. Collision protection in a coupling for rail-mounted vehicles of the type that comprises a coupling element (1) in which two parts (6, 7) translationally movable in relation to each other are included, between which at least one energy-extincting or energy-absorbing element (23, 24) of deformable character is arranged, c h a r a c t e r i z e d in that the energy-extincting element consists of a tube (23, 24), which is deformable by radial compression as a consequence of having a first, tapering end portion (34) inserted into a thinner bore (25, 26) in a first part (7) and an opposite, free end (39) distanced from the second part (6) in order to, upon displacement of the two parts (6, 7) in the direction of each other, be pressed axially into the bore, more precisely after rupture of one or more triggering members (19), which initially hold together said parts in a fixed state in which the deformation tube (23, 24) is completely inactive.

2. Collision protection according to claim 1, c h a r a c t e r i z e d in that the bore (25, 26) is formed with a funnel-like mouth (27), which widens in the direction of the deformable tube and in which the rear end portion (34) of said tube is pressed in.

3. Collision protection according to claim 1 or 2, c h a r a c t e r i z e d in that the deformable tube (23, 24) is of a cylindrical basic shape.

4. Collision protection according to claim 2 or 3, c h a r a c t e r i z e d in that the end portion (34) of the tube (23, 24) inserted into the mouth (27) of the bore (25, 26) has a conical outside (35).

5. Collision protection according to claim 4, c h a r a c t e r i z e d in that the funnel-like mouth (27) of the bore is conical and has a cone angle (λ), which is at least

equally large as the cone angle (γ) of the rear end portion (34) of the tube (23, 24), and which amounts to at least 5° and at most 20°.

6. Collision protection according to any one of the preceding claims, c h a r a c t e r i z e d in that the free end of the deformable tube (23, 24) consists of a ring-shaped, planar surface (39), which extends perpendicularly to the geometrical centre axis (C) of the tube.

7. Collision protection according to any one of claims 4-6, c h a r a c t e r i z e d in that the deformable tube (23, 24) is fixedly pressed into the mouth (27) of the bore (25, 26) by means of a clamping element (43), which is accessible from a rear end of the bore (25, 26).

8. Collision protection according to claim 7, c h a r a c t e r i z e d in that the clamping element consists of a nut (41) and bolt (42), which extend between two stopping elements (40, 43) one of which (40) is fixed in the clamped end of the tube (23, 24) and the other is pressed against a ring-shaped shoulder (32) in the transition between a rear section (31) of the bore that has a larger diameter than a section (30) being in front.

9. Collision protection according to any one of the preceding claims, c h a r a c t e r i z e d in that the distance between the free end of the deformation tube and said second part (6) amounts to at least 5 mm.

10. Collision protection according to any one of the preceding claims, c h a r a c t e r i z e d in that a plurality of deformable tubes (23, 24) are associated with said first part (7), the free ends (30) of which tubes are located at differently large distances from the second part (6) in order to initiate deformation of the tubes at different points of time after a commenced displacement of the two parts (6, 7) towards each other.

11. Collision protection according to claim 10, c h a r a c t e r i z e d in that at least two different tubes (23, 24) have different outer diameters (D_1).

12. Collision protection according to claim 10 or 11, c h a r a c t e r i z e d in that the tubes (23, 24) have different wall thicknesses (T).

13. Collision protection according to claim 11 and 12, c h a r a c t e r i z e d in that the wall thickness (T) of the tubes is in inverse proportion to the diameter (D_1) so far that a thicker tube (23) has a smaller wall thickness (T) than any thinner tube (24).

14. Collision protection according to any one of the preceding claims, c h a r a c t e r i z e d in that said triggering member (19) consists of one or more screws (19), which extend parallel to the direction of the relative motion between said parts (6, 7) in order to break by attaining a predetermined ultimate tensile strength after strain.

15. Collision protection according to claim 14, c h a r a c t e r i z e d in that the individual screw (19) is formed with a waist (21) the diameter of which decides the ultimate tensile strength of the screw.

16. Link device for permanently connecting two rail-mounted vehicle units, comprising two link members or link parts (1, 2) connected via a common hinge (3) at least one of which (1) is divided into two parts translationally movable in relation to each other, namely a front link head (6) connected to the hinge (3) and a rear carrier (7) fixedly connectable to a vehicle unit, between these parts (6, 7) an energy-extincting or energy-absorbing element of deformable character serving as collision protection being arranged, c h a r a c t e r i z e d in that a collision

protection made in accordance with any one of claims 1-12 is used as collision protection, the energy-extinction element of which consists of a tube (23, 24), which is deformable by radial compression as a consequence of having a rear, tapering end portion (34) inserted into a thinner bore (25, 26) in a back piece (9) included in the carrier (7), and which at an opposite, front end (39) is distanced from the link head (6).

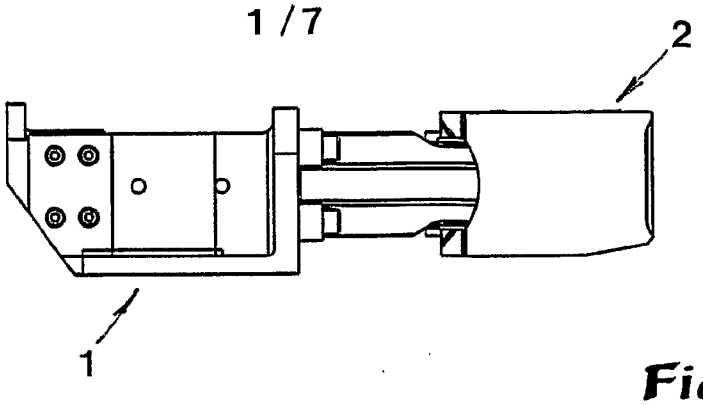


Fig 1

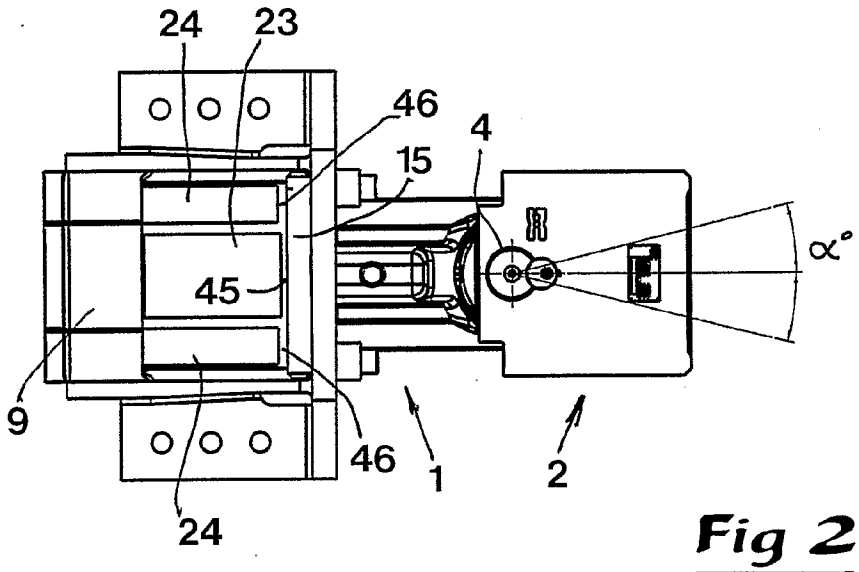


Fig 2

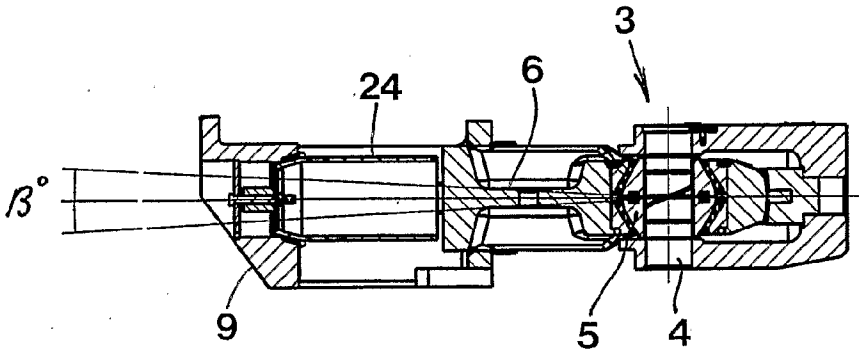


Fig 3

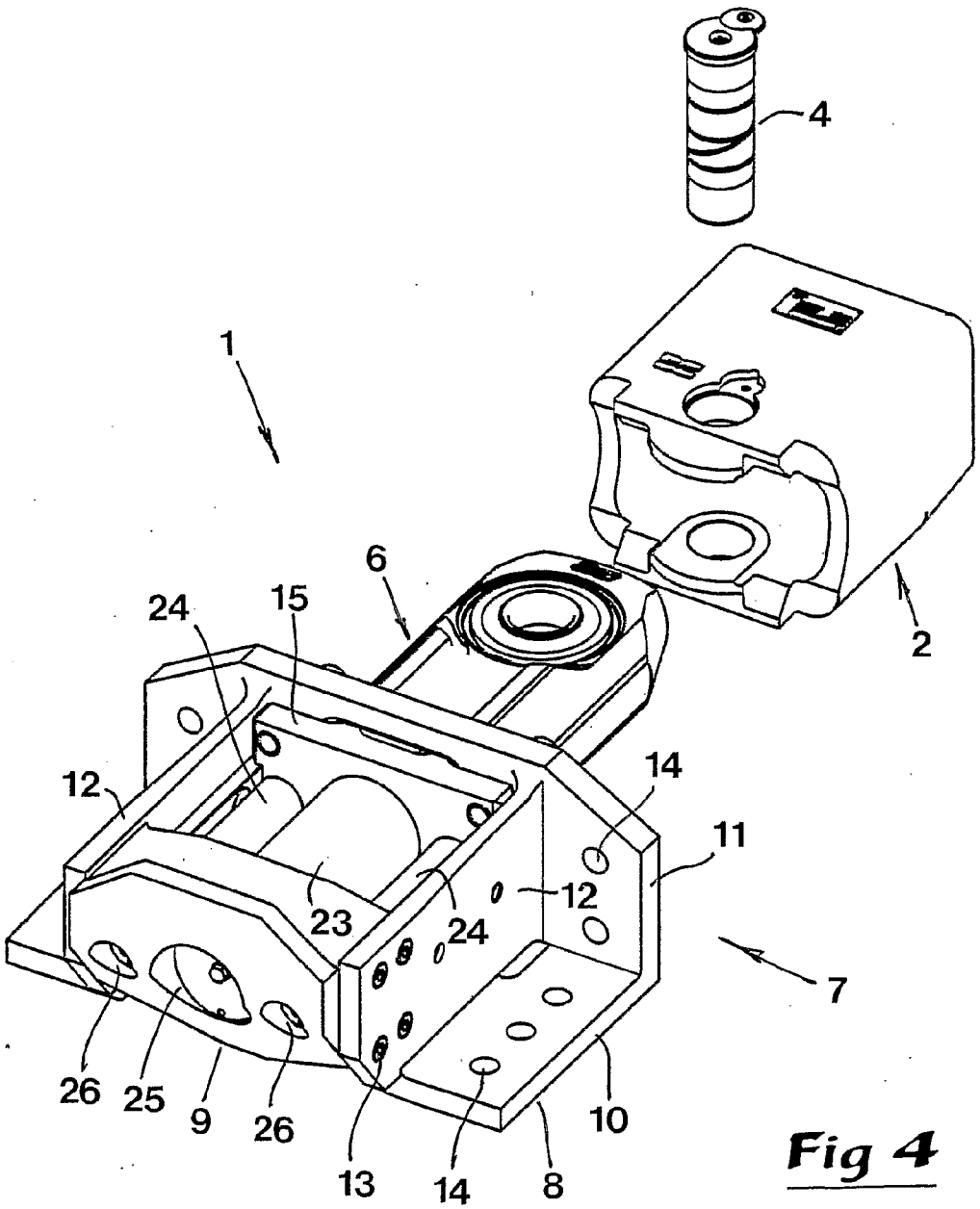
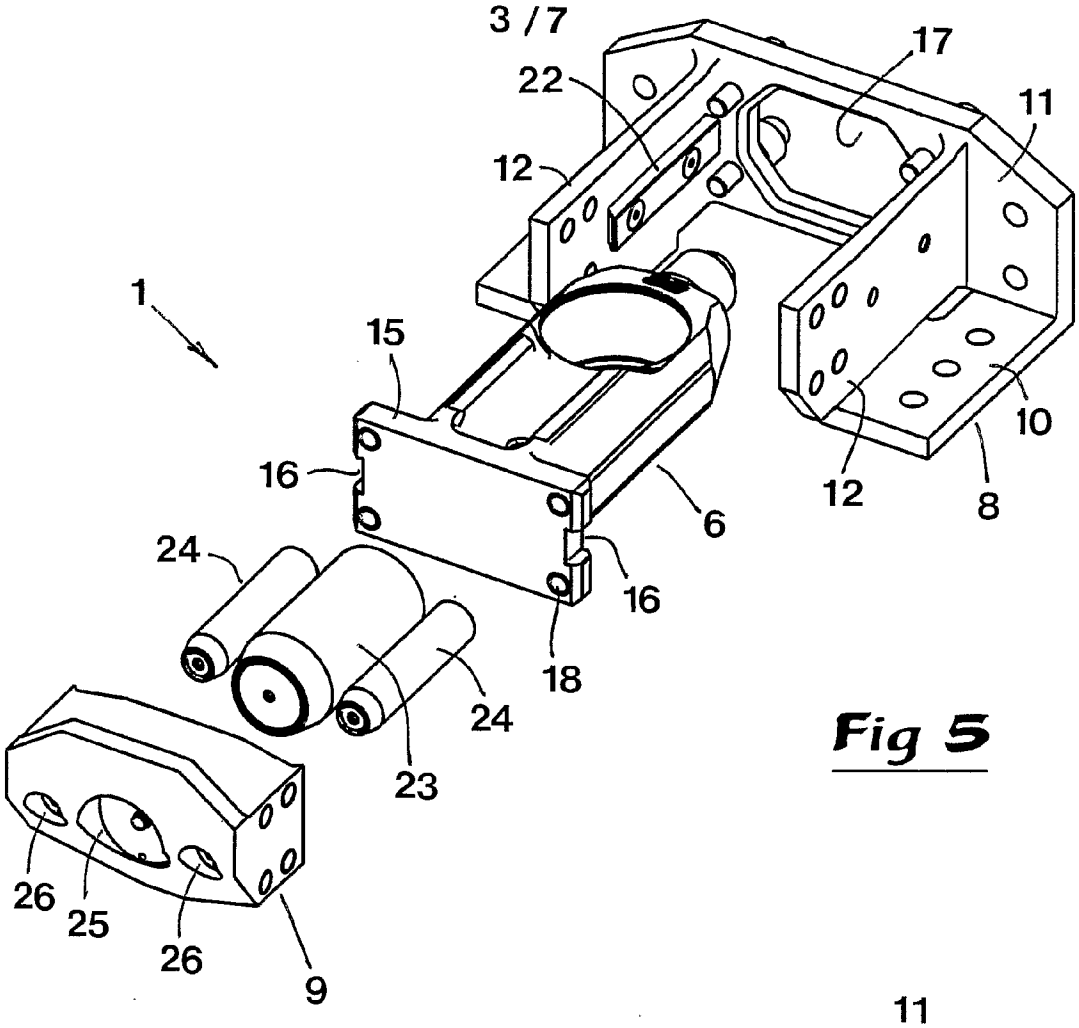


Fig 4


17
22
11
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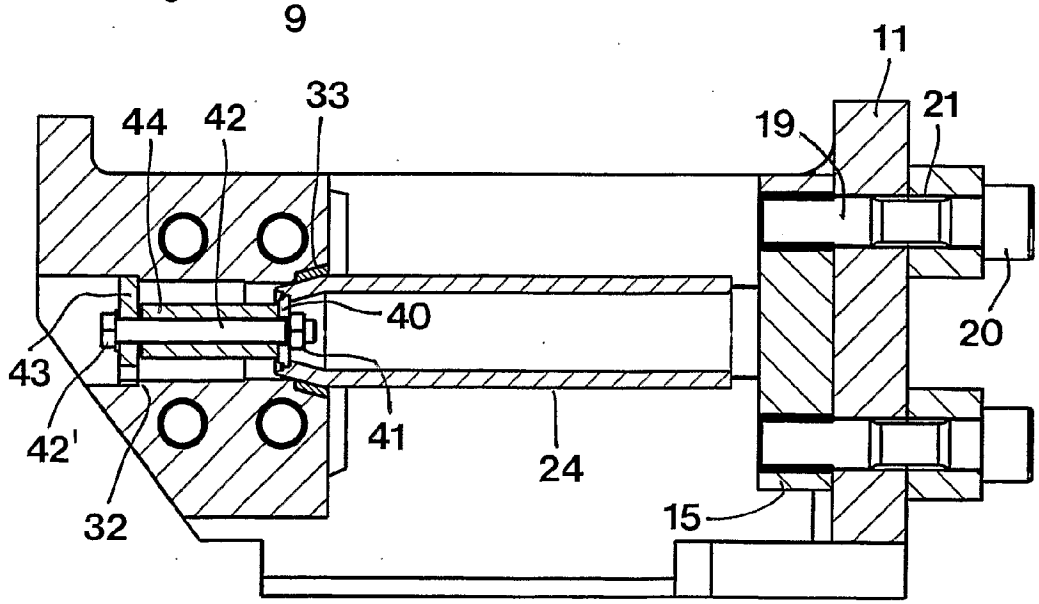
25
26
9

Fig 5


11
33
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42
19
21
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43
41
42'
24
32
15

Fig 6

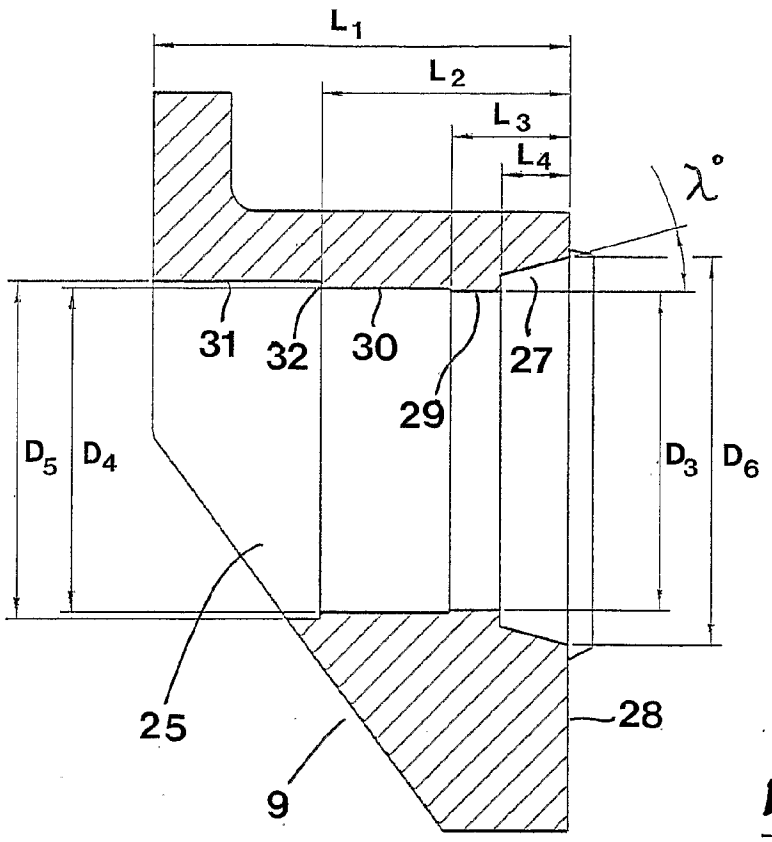
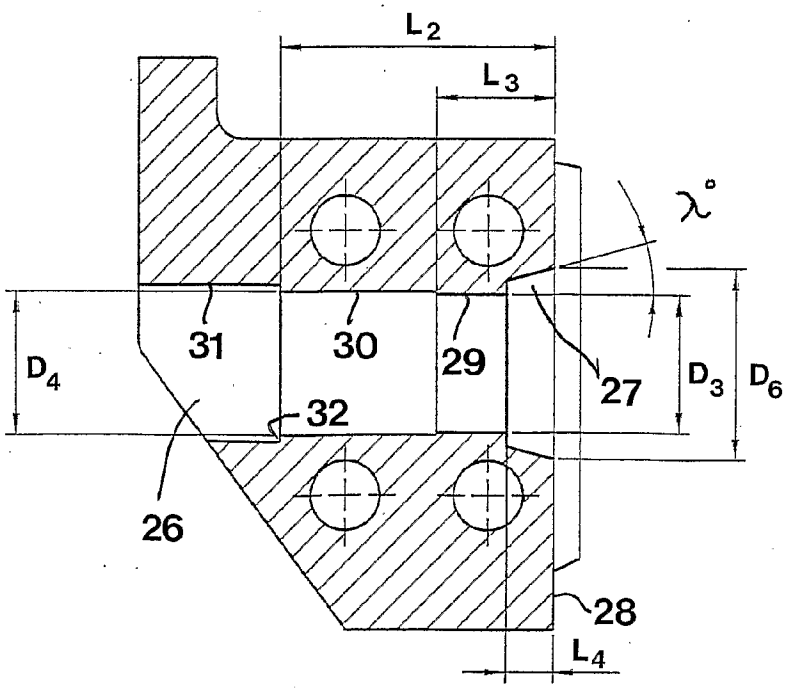

L1
L2
L3
L4
λ°
31
32
30
29
27
D5
D4
D3
D6
25
28
9

Fig 7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L3
λ°
31
30
29
27
D4
D3
D6
32
26
28
L4

Fig 8

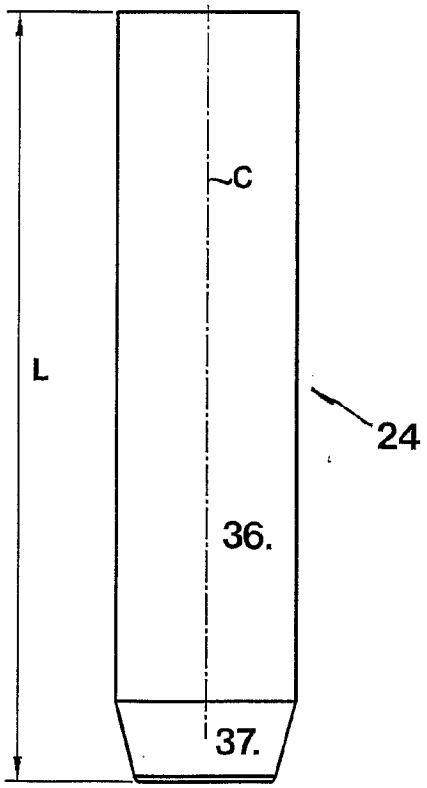

Fig 9

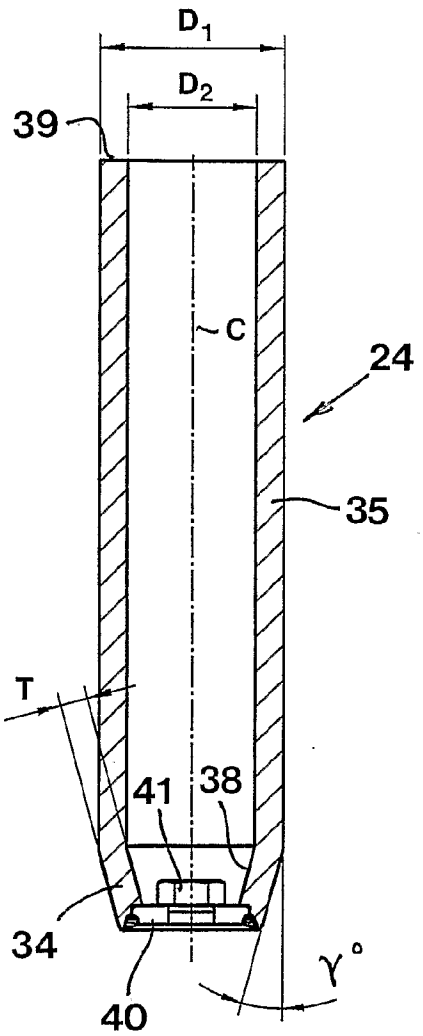

Fig 10

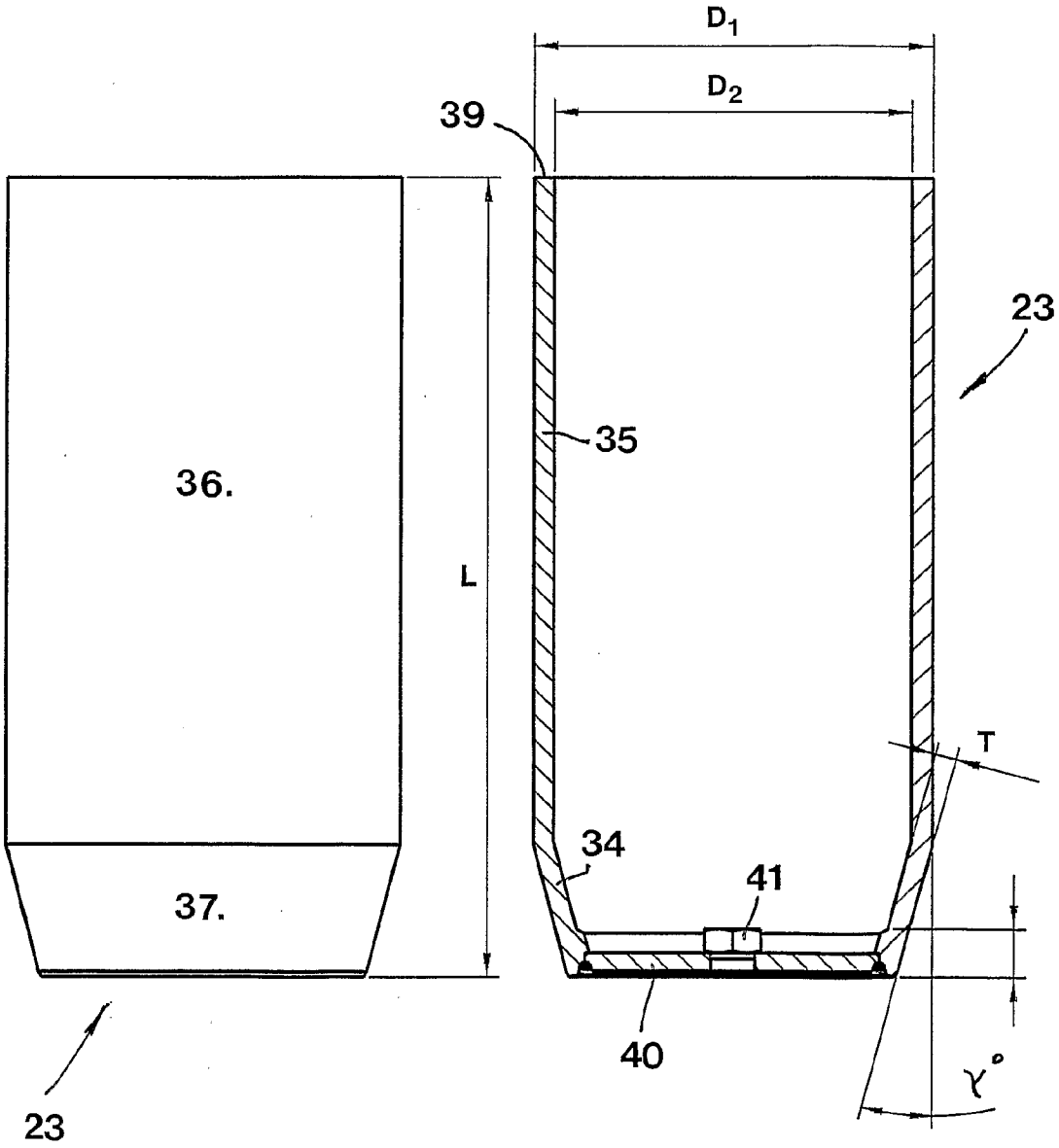

Fig 11

Fig 12

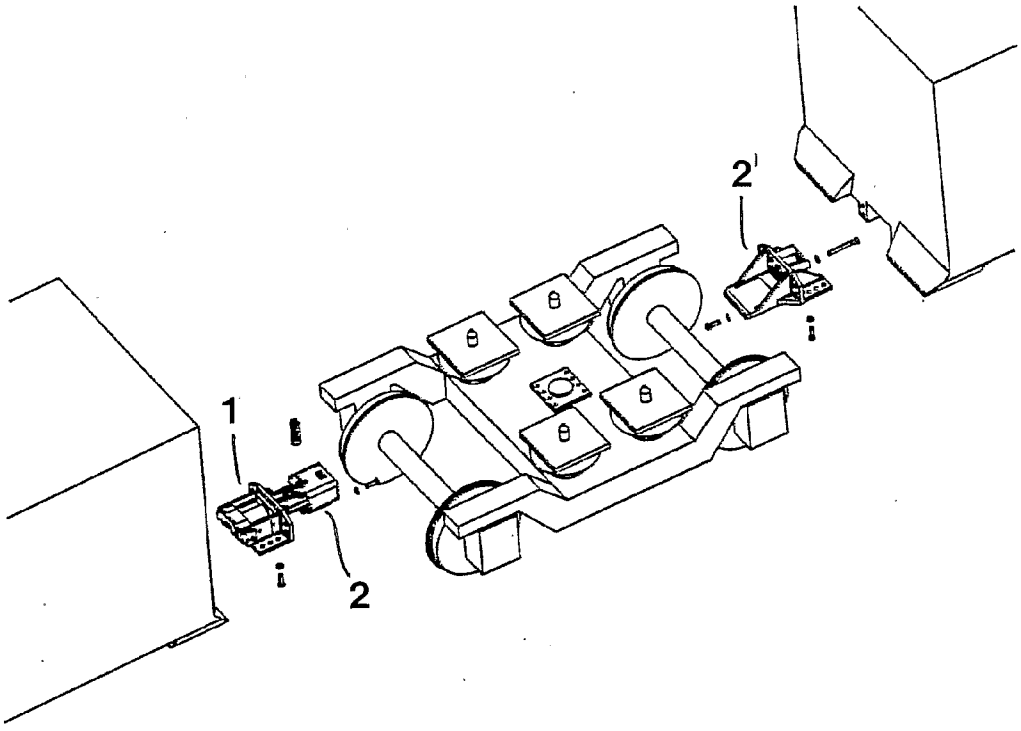

Fig 13

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 2004/001255

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: B61G 5/02, B61G 9/10
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: B61G, B61D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-INTERNAL, WPI DATA, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 1312527 A1 (VOITH TURBO SCHARFENBERG GMBH & CO KG), 21 May 2003 (21.05.2003) --	1-16
A	DE 10153460 A1 (VOITH TURBO SCHARFENBERG GMBH & CO KG), 22 May 2003 (22.05.2003) --	1-16
A	GB 1202308 A (SCHARFENBERGKUPPLUNG GMBH), 12 August 1970 (12.08.1970) --	1-16
A	GB 1275035 A1 (SCHARFENBERGKUPPLUNG GMBH), 24 May 1972 (24.05.1972) --	1-16

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
10 December 2004	15 -12- 2004
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Christer Jönsson/EK Telephone No. +46 8 782 25 00

Form PCT/ISA/210 (second sheet) (January 2004)

INTERNATIONAL SEARCH REPORT

Information on patent family members

30/10/2004

International application No.
PCT/SE 2004/001255

EP	1312527	A1	21/05/2003	SE	1312527	T3	
				AT	242138	T	15/06/2003
				DE	20121562	U	02/01/2003
				DE	50100297	D	00/00/0000
				DK	1312527	T	29/09/2003
DE	10153460	A1	22/05/2003	NONE			
GB	1202308	A	12/08/1970	CH	519409	A	29/02/1972
				DE	1530223	A,B,C	28/08/1969
				FR	1599086	A	15/07/1970
				NL	134701	C	00/00/0000
				NL	6816032	A	13/05/1970
GB	1275035	A1	24/05/1972	BE	764439	A	16/08/1971
				CH	525794	A	31/07/1972
				DE	1912049	A,B,C	01/10/1970
				FR	2089150	A	07/01/1972
				NL	7103259	A	13/09/1972